Research Report 1319

AN EVALUATION OF MINORITY AND FEMALE PERFORMANCE IN ARMY ROTARY WING AVIATION TRAINING

Volume II: Evaluation Report

William R. Brown and John A. Dohme
Army Research Institute
and
Daniel C. Wick
Canyon Research Group

ARI FIELD UNIT AT FORT RUCKER, ALABAMA

U. S. Army
Research Institute for the Behavioral and Social Sciences

May 1980

U. S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the Deputy Chief of Staff for Personnel

JOSEPH ZEIDNER
Technical Director

FRANKLIN A. HART
Colonel, US Army
Commander

NOTICES

DISTRIBUTION: Primary distribution of this report has been made by ARI. Please address correspondence concerning distribution of reports to: U. S. Army Research Institute for the Behavioral and Social Sciences, ATTN: PERI-TP, 5001 Eisenhower Avenue, Alexandria, Virginia 22333.

FINAL DISPOSITION: This report may be destroyed when it is no longer needed. Please do not return it to the U. S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Research Report 1319	2. GOVT ACCESSION NO. AD-A130959	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) AN EVALUATION OF MINORITY AND FEMALE PERFORMANCE IN ARMY ROTARY WING AVIATION TRAINING. VOLUME II: EVALUATION REPORT		5. TYPE OF REPORT & PERIOD COVERED Final Jul 74 - Jul 79 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) William R. Brown and John A. Dohme, ARI and Daniel C. Wick, Canyon Research Group		8. CONTRACT OR GRANT NUMBER(s) --
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Research Institute for the Behavioral and Social Sciences (PERI-SR) 5001 Eisenhower Avenue, Alexandria, VA 22333		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 2Q263731A792
11. CONTROLLING OFFICE NAME AND ADDRESS Director of Training US Army Aviation Center Fort Rucker, AL 36362		12. REPORT DATE May 1980 13. NUMBER OF PAGES 124
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) --		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE --

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

--

18. SUPPLEMENTARY NOTES

Research accomplished by ARI Field Unit at Fort Rucker, AL. The report is published in two volumes. Volume I is an Executive Summary; Volume II is the Evaluation Report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Training Evaluation
Army Training
Aviation Training
Minority Performance
Female Performance

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

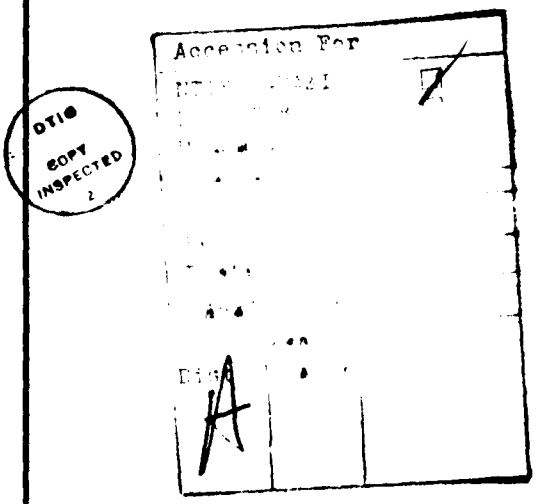
This report contains the evaluation of minority (Black, Hispanic, Asian, American Indian) and Female performance in the Army's Initial Entry Rotary Wing flight training program. Each minority group was compared to a matched sample of majority students. The groups were matched on FAST score, GT score, education level, age, rank, and source of entry. The performance of the two groups (each minority and its matched control group) was compared on the following criteria: (1) Warrant Officer Candidate Military Development Course grades;

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(2) Academic grades by phase of training; (3) Flight performance grades by phase of training; (4) Overall grade; (5) Attrition experience during the Warrant Officer Development Course and; (6) Attrition experience during the flight portion of training.



Research Report 1319

AN EVALUATION OF MINORITY AND FEMALE PERFORMANCE IN ARMY ROTARY WING AVIATION TRAINING

Volume II: Evaluation Report

William R. Brown and John A. Dohme
Army Research Institute
and
Daniel C. Wick
Canyon Research Group

Submitted by:
Charles A. Gainer, Chief
ARI FIELD UNIT AT FORT RUCKER

Approved by:
Edgar M. Johnson, Director
SYSTEMS RESEARCH LABORATORY

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
5001 Eisenhower Avenue, Alexandria, Virginia 22333

Office, Deputy Chief of Staff for Personnel
Department of the Army

May 1980

Army Project Number
2Q263731A792

Manpower and
Personnel

ARI Research Reports and Technical Reports are intended for sponsors of R&D tasks and for other research and military agencies. Any findings ready for implementation at the time of publication are presented in the last part of the Brief. Upon completion of a major phase of the task, formal recommendations for official action normally are conveyed to appropriate military agencies by *briefing or Disposition Form.*

FOREWORD

This report presents the results of a research effort in support of the US Army Aviation Center's Human Relations and Assistance Program for Students (HRAPS). The HRAPS program is intended to provide students assistance for a smooth transition into the Fort Rucker training environment and surrounding communities, with the primary focus on successful completion of training.

As a part of the process of providing assistance to students, ARI Fort Rucker Field Unit was tasked to perform several activities. The projects performed by ARI generally related to two issues: (1) the evaluation of the aviator trainee selection process, and (2) the evaluation of student performance as a function of minority/majority status in the Army Initial Entry Rotary Wing (IERW) flight training program.

The evaluation of the selection process evolved into several projects, which will be detailed in future ARI technical reports. This report concerns only the evaluation of minority and female performance in IERW program with a focus on the following objectives:

(1) to determine if minority and/or female students have academic and/or flight performance grades equivalent to their counterpart majority students;

(2) to determine if attrition differs for minority female and majority students;

(3) to identify, if differences exist, the aspects of the IERW program in which the differences occurred;

(4) make recommendations, where possible, concerning ways to continually improve the IERW program for all students.

The report of this evaluation is large and contains several graphs and tables. For this reason, the report is divided into two parts, the executive summary and the evaluation report.

This evaluation is intended for use by the US Army Aviation Center to assist in the continuing effort to improve the efficiency of the selection and training of Army aviators.

JOSEPH ZEIDNER
Technical Director

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to the following individuals or organizations for their invaluable contributions to the project.

Dr. Michael G. Sanders, Technical Team Manager, US Army Research Institute Field Unit, offered useful and thoughtful comments and discussion plus providing a great deal of guidance and direction to the overall study design, data collection, and documentation effort.

Captain Jan Lichtig, Data Collection Supervisor, Directorate of Training Developments, competently supervised the numerous individuals who searched files, boxes, and cabinets for data.

The entire staff of the Student Management Office, Operations Branch, Directorate of Training, provided suggestions and assistance in locating and interpreting grade folders.

The entire staff of the Academic Records Office, Student Personnel Operations, Directorate of Personnel and Community Activities, assisted in locating and evaluating student records.

A special thanks is extented to Mrs. Sharon Kelley, US Army Research Institute, who diligently spent many hours typing and revising the several drafts of this report.

AN EVALUATION OF MINORITY AND FEMALE PERFORMANCE IN ARMY ROTARY WING AVIATION TRAINING

BRIEF

Requirement:

To evaluate the IERW program by ascertaining if there are differences in performance and/or attrition between minority and female groups and their counterpart white males when the students are matched in terms of their scores on flight related selection tests and on military experience.

Procedure:

The comparisons of each minority group (Black, Hispanic, Asian, American Indian) and the female group was accomplished in four phases:

(a) comparison of academic and military development grades for Warrant Officer Candidates (WOCs);

(b) comparison of academic and flying performance grades for Primary, Transition, Instruments, Night, and Tactics stages of training as well as the overall IERW grade;

(c) comparison of attrition experience during the Warrant Officer Candidate Military Development Course (WOCMDC);

(d) comparison of attrition experience during the flight portion of IERW training.

Findings:

(a) No significant differences were found in performance grades (academic or military development) during WOCMDC.

(b) The only group found to have a statistically significant difference in academic grade was the Black group during the Primary stage of training. Although the primary academic average was significantly lower for Blacks, the average was much higher (85.27) than the minimum score (70) required for passing.

. There were no significant differences in flight performance grades across the stages of training.

. There were no significant differences in IERW overall grade.

(c) The Hispanic group was the only group to show significantly more recycles than their matched majority group.

. There were no significant differences in elimination between any minority and matched majority group.

(d) During flight training only two minority groups (Blacks and Hispanics) had significantly more recycles than did their matched majority groups. Also the Black group received significantly more eliminations than did their matched majority.

Utilization of Findings:

The results of this study will be used by the US Army Aviation Center to ensure that the flight training program maximizes the training for all students.

TABLE OF CONTENTS

PAGE NO.

FIGURES

TABLES

INTRODUCTION

In July 1979, the US Army Aviation Center (USAAVNC), Fort Rucker, initiated activities and policies which evolved into what is now called the USAAVNC Human Relations and Assistance Program for Students (HRAPS). The purpose of HRAPS is to: "ensure that all reasonable actions are taken to provide maximum assistance to all students who apply for and are assigned to the US Army Aviation Center for training. These actions include assistance for a smooth transition into the Fort Rucker training environment and surrounding communities, with the primary focus on successful completion of training." (USAAVNC Regulation 600-3).

The US Army Research Institute (ARI) Fort Rucker Field Unit was tasked to perform several activities in support of HRAPS.[1] The project or activities being performed by ARI generally relate to two issues: (1) the evaluation of the aviator trainee selection process, and (2) the evaluation of student performance as a function of minority/majority status in the Army Initial Entry Rotary Wing (IERW) flight training program.

The evaluation of the selection process evolved into several projects which will be detailed and reported upon in subsequent ARI Technical Reports. The research reported herein concerns work related to the second general issue. Specifically, an evaluation of minority and female performance in the IERW program at Fort Rucker.

The objective of this report is to evaluate the IERW program by: (1) determining if minority and/or female IERW students have academic and/or flight performance scores equivalent to their counterpart majority students; (2) identifying, if performance differences are found, the aspects of the IERW program in which the differences occurred; (3) determining if attrition (recycles and eliminations) differs for minorities and females and white males; (4) making recommendations, where possible, concerning ways to continually improve the IERW training program for all students.

This report represents the evaluation of minority performance in the Army's IERW flight training course and involves comparisons of five groups of minority students:

(1) Blacks

(2) Hispanic, including persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish origin

(3) Asian, including Pacific Islanders

(4) American Indian, including Alaskan natives

(5) Females.

---

[1] A glossary of terms is located at Appendix A to assist the reader in understanding aviation related terms and acronyms which may be unfamiliar.

Each of these were chosen based on the definition of "relevant" races and ethnic groups discussed in the Uniform Guidelines on Employee Selection Procedures, Section 4B.

The approach used for the current evaluation closely followed that used by Baisden and Doll, 1978, in their investigation of black vs white performance in Naval aviation training. Both investigations relied on matching each minority student with a white male on entry scores/variables that predict flight training performance. This approach assures that performance comparisons were made between students who had entered flight training with essentially the same attributes. That is, the intent of the study was to ascertain if there were differences in performance and/or attrition between minority groups and counterpart white males when they are matched in terms of entry scores or flight related selection tests and demographic variables.

The reader should understand, at this point, that if differences between minority and/or female groups and their white male counterparts occur, that is by no means conclusive evidence of discrimination. A simple group difference in performance grades does not in itself establish that bias has or is occurring. Differences in performance scores between a minority and a majority (white male) group may reflect bias in the selection process, performance evaluation methods, instructor pilots, other conditions, or it may reflect genuine differences in performance (Guion, 1976).

METHOD

SUBJECTS

The subjects used for this evaluation were drawn from the population of all Commissioned Officers, Warrant Officers, and Warrant Officer Candidates (WOC) who had entered the flight training program after July 1974 and graduated/attrited from the program by July 1979. Class rosters and flight records were reviewed in an attempt to locate the flight records of as many individuals as possible. This extensive effort led to the identification of 4,295 students who entered the IERW program and obtained at least one academic, military development, or flight grade. In the case of WOCs, the one performance grade could have been received in the Warrant Officer Military Development Course (WOCMDC). For each of the 4,295 students, the following information was collected when available:[2]

1. Name
2. SSN
3. Rank
4. Age
5. Class in which student began training
6. Sex (M or F)
7. Race/ethnic background (Black, Hispanic, Asian, American Indian, and Caucasian)
8. Source of entry
9. Flight Aptitude Selection Test (FAST) Score
10. GT score
11. Education level in years

Race/ethnic identification for each individual was obtained from a Student Information Card completed by students entering the flight program. This card contained six (6) categories from which the student could choose:

---

[2]It should be noted that some student records were incomplete, therefore, some of the required information could not be found. Students were eliminated from the study when critical data points, such as ethnic status/background, were not available.

1. Black

2. Oriental (Asian)

3. Spanish (Hispanic)

4. American Indian

5. Caucasian

6. Other

Students who selected the "other" category were required to write in the ethnic background they claimed. In all cases the ethnic background provided closely corresponded to one of the five major categories, e.g., Black Jamaican, Samoan, and Eskimo. These students were placed into the appropriate major classification for purposes of this study.

Table 1 presents the number of officers and WOCs identified by ethnic background for the identified time period. The WOC category includes students in the WOCMD course, whether or not they completed WOCMDC and entered flight training. Infrequently, warrant officer students receive flight training after they have received their warrant appointments. These individuals do not attend the WOCMDC and are considered officers in training and are included in the officer category in Table 1.

TABLE 1

OFFICER[a] AND WARRANT OFFICER CANDIDATE IERW STUDENTS
JULY 1974 THROUGH JULY 1979

	SEX AND ETHNIC GROUP					
RANK	CAUCASIAN	BLACK	HISPANIC	ASIAN	AMERICAN INDIAN	FEMALE
OFFICER	1463	80	38	8	20	27
WARRANT OFFICER CANDIDATE	2476	45	41	20	27	50
TOTAL	3939	125	79	28	47	77

[a]Warrant Officers who received their warrant appointments prior to flight training are included in the officer category.

STUDENT MATCHING

After minority and female students were identified, a white male student was selected for the control sample by matching each pair on the following variables:

1. Flight Aptitude Selection Test (Old FAST)
2. General Technical (GT) Test
3. Class
4. Education
5. Age
6. Rank
7. Source of entry

Again, the intent of matching each minority student with a counterpart white male was to ensure that the performance comparisons would be made across groups of people who entered the flight program with essentially the same aptitudes and military experience. This approach allows one to make the assumption that any observed performance differences are not due to differences in these entry level attributes, but rather due to other factors. The finding of performance differences indicates that a relationship between minority status and performance exists. The identification of the cause(s) for differences was not an objective of this study.

Since the probability of exactly matching each minority with a white male on several variables is extremely low, envelopes were developed for each matching variable. The following is an outline of the matching envelopes used:

(1) FAST WOC ±15
CO ±30

In each case it was decided to make the envelope for the Old FAST scores $\pm \frac{\sigma}{2}$ to allow a match to occur within $\pm.5\sigma$ of the minority score. The observed σs were 29.9 and 59.3 for the total sample of WOCs and officers, respectively.

(2) GT ±10

The envelope of $\pm\frac{\sigma}{4}(\pm\frac{20}{4})$ originally selected to ensure a match within $\pm.25\sigma$ between the minority and majority student proved to be too restrictive. Opening the envelope to $\pm.5\sigma(\pm10)$ was necessary to find a majority to match each minority. A minimum GT score of 110 is required for entry to Warrant Officer Candidate flight training.

(3) Class number ±15

In order to ensure that minorities were matched with white males trained under the same curriculum and standards, an envelope of ±15 classes was selected. Class numbers alternate between officer and WOC,

i.e., even numbered classes are officer classes and odd number classes denote WOC classes. Therefore, effectively the envelope for each group is ±7 classes which corresponds to ±3½ months in the IERW program.

(4) Education

Education level was denoted by the number of years of formal education, i.e., high school equals 12, one year of college equals 13, and so forth. The students were matched through assignment to one of the following educational categories:

(a) High school only

(b) Some college (13, 14, or 15) but did not graduate

(c) College degree or above

(5) Age ±5 years

±5 years was selected as the age envelope because 5 years was the largest of the σ's when $\overline{X}$ and σ of age were calculated by group, i.e., Caucasian, Black, Asian, etc.

(6) Rank

In general, the matching by rank was made 1 grade. The exact procedure was as follows:

(a) WOC matched with WOC

(b) 2LT with 2LT or 1LT
1LT with 2LT, 1LT, or CPT
CPT with 1LT, CPT, MAJ
MAJ with CPT, MAJ, LTC

(7) Source

There are several possible methods for an individual to gain entry into the Army's flight training program. WOC's can be admitted directly from Basic Combat Training (BCT) with very little military service or can be admitted to the program after having spent several years in the military service. The matching criterion used considered whether or not the WOC student came from essentially a civilian environment (having just completed BCT) or had spent a longer period of time in the military. For classification purposes, a person who had 6 months of service or less was considered to have been a civilian entry to the program. Over 6 months was considered as prior enlisted.

Each person who entered the flight training program as a commissioned officer or warrant officer was categorized by their source of commission. Therefore, the following categories were used to identify the source of entry into the program:

(a) WOC - Civilian entry

(b) WOC - previous enlisted

(c) ROTC

(d) OCS or direct

(e) United States Military Academy (USMA)

Since it was not possible to obtain all matching information for all students, some alterations to the basic matching criteria were made:

(a) Less than 10% of the minority officers entered the flight program from the USMA, therefore, these students were grouped with those students entering from OCS for matching purposes to improve the size of this selection group.

(b) Officer students do not have GT scores. Therefore, GT scores were not used as a matching variable for officers.

(c) In many instances it was also not possible to obtain GT scores for students who attended flight training as WOCs. The GT score is not a part of the records of an enlisted person after that person receives a warrant appointment and his/her records are changed to officer records.

The matching was performed via a computer program which matched each minority to a caucasian male based on the criteria for each variable noted above. In those instances in which all the matching data were not available the following rules applied.

(a) Students missing class number were deleted from the study. Student flight records could be found for only those individuals with class numbers.

(b) Students missing the FAST score were deleted from the study. FAST score was considered the primary matching variable. Eastman and McMullen, 1978, identified the predictive validity (using IERW grades and course dispositions as criterion measures) as .38 for the FAST Warrant Officer Candidate Battery (WOCB) and .44 for the FAST Officer Battery (OB).

(c) Students missing age, education level, or source of entry data were matched based on consideration of all other variables. Approximately 20% of the minorities and females had one or more of these data elements missing. Most often, when the student was missing a single data element, it was source of entry.

Extensive efforts were made to obtain missing information. A list of those individuals missing FAST, GT, AGE, and/or EDUCATION was sent to MILPERCEN and the data obtained were used to fill in missing data points. A TREDS (TRADOC EDUCATION DATA SYSTEM) printout was also obtained and used to update missing data points. Following these efforts and several checks of data available at Fort Rucker, any missing data elements were assumed not to be obtainable.

Once each minority student was determined to have appropriate matching data, a search of his/her flight school records was made. This search was made to determine if performance scores (academic or flight) were available. If no performance data could be found, that student was eliminated from the study. Matched majority students (those matched with a minority or female) having no performance data were likewise eliminated from the study. Table 2 presents the number of minorities, by ethnic background, who had both matching and performance data. The total sample used for the evaluation includes those 192 minorities plus the 192 matched control majority students.

TABLE 2

NUMBER OF MINORITIES AND FEMALE STUDENTS (JUL 74 - JUL 79)
HAVING BOTH MATCHING AND PERFORMANCE SCORES

	SEX AND ETHNIC GROUP					
RANK	BLACK	HISPANIC	ASIAN	AMERICAN INDIAN	FEMALE	TOTAL
OFFICER	27	16	3	9	15	70
WARRANT OFFICER CANDIDATE	30	30	15	20	27	122
TOTAL	57	46	18	29	42	192

To obtain an assurance that the matching procedure was appropriate, each minority group was compared to their matched control majorities and to the total majority sample across FAST, GT, education level, and age (see Appendix B).

Tables C1 through C5, Appendix C contain the critical t values[3] required (t_c) and the t values observed (t_o) for each group comparison. From these tables it can be seen that there were no significant differences between any minority group and their matched control group.

These findings indicate that the matching procedure was effective and that the two groups (minority and their matched control) entered training with equivalent aptitudes and military experience, age, and education level.

PROCEDURE

MATCHING VARIABLES AND DESIGN

Group performance on the matching variables is shown in Tables C1 through C5 of Appendix C. These tables present the mean FAST and GT scores, mean education level and age for Officers and WOCs by minority group along with their matched control white males (MC). In order to determine the effectiveness of the matching technique, each minority group was statistically compared (paired-t test) to each group's matched control. The observed paired-t value (t_o) and the critical t value (t_c) (Cohen, 1977), Appendix B, required in order for the difference between the minority and MC to be significant were computed. It can be seen from these tables that no significant differences ($\alpha = .05$ and $\beta = .2$) were found between minority groups and their MCs. The findings of no significant differences between minority groups and their MCs indicates that the matching procedure was effective and that the two matched groups entered the aviation program essentially equivalent on the matching variables.

As a point of interest, the reader may observe that officers and WOCs do differ on several of the matching variables, e.g., FAST scores, age, and education level. The FAST score differences can be attributed to the fact that two versions of the FAST exist, the Officer Battery (FAST-OB) and the WOC Battery (FAST-WOCB). The two versions are different in number and content of subtests and have different minimum scores to qualify for flight training, therefore, the difference in FAST scores between officers and WOCs is certainly expected. Past minimum FAST[4] scores have generally been 155 and 300 for the FAST-OB and FAST-WOCB, respectively.

Since the majority of officers have college degrees, and warrant officers do not, it is also expected that officer students would have a higher reported educational level. The data presented in Tables B1 through B5 support these expectations.

---

[3] A discussion of the rationale for and method of developing t_c values can be found at Appendix B.

[4] Recent changes to the minimum scores and to the FAST test have occurred. In October 1979, the minimum WOC-B score was lowered to 270. A new Revised FAST test was implemented 1 January 1980, DA Circular 611-77. The Revised FAST has one battery given to both Officer and Enlisted with a minimum score of 90 required for entry to flight training.

Second, a paired-t statistic was used to test for differences between the minority groups and the total majority group (all white males) on FAST, GT, education level, and age. Again, an α of .05 and β of .2 was selected. This analysis, presented in Appendix D, Tables D1 through D5, shows several minority groups to be significantly different from the total majority group. Black officers had significantly lower FAST scores (t_o = 5.7) than did the total majority officers, Hispanic WOCs had significantly lower GT scores (t_o = 3.15) and were older (t_o = 2.86) than the total majority WOCs, WOC females had significantly lower (t_o = -3.05) FAST scores than did the total majority WOCs. None of the other comparisons showed significantly different t_o values on FAST, GT, education level, or age. The occurrence of these differences implies that if a completely random sample of majority students had been used as the comparison group, significant differences in entering aptitudes may have existed, thus making interpretation of performance scores difficult.

The performance of each minority group (Black, Hispanic, Asian, American Indian, and Female) was compared with that of each group's matched control on several critical training scores and on attrition experience. The performance evaluation was divided into essentially four phases.

Phase 1 - Student performance during WOCMDC

(a) Academic grades

(b) Military Development grades

Phase 2 - Officer and WOC student grades during flight training

(a) WOC only - Military Development grades during initial 10 weeks of flight training (Presolo + Primary)

(b) Academic and flying performance grades for primary, transition, instruments, night, and tactics stages

- Academic grades
- IP putup grades
- Checkride evaluation grades
- Stage grades
- Overall grade

Phase 3 - Attrition experience during WOCMDC

(a) Number of recycles and eliminations

(b) Reason categories for attrition

Phase 4 - Attrition experience during flight portion of training

(a) Number of recycles and eliminations

(b) Reason categories for attrition

PHASE 1 - STUDENT PERFORMANCE DURING WOCMDC

WOCMDC Academic Grades - The records of those minorities and their matched control majorities who attended WOCMDC were reviewed to obtain performance data. During WOCMDC each WOC receives a weekly academic grade and a weekly military development grade. Academic grades range from the minimal passing grade of 70 to a maximum grade of 100. Some students who do not obtain a passing grade on a weekly exam are given, under certain conditions, the opportunity to retake the exam. In these cases the score recorded is the minimal passing score (if a passing score was obtained). The score used for statistical comparison was the arithmetic mean of all academic grades obtained during WOCMDC. This grade was termed "WOCMDC Academic Grade."

WOCMDC Military Development Grades - Also during WOCMDC WOCs receive weekly military development scores. This grade reflects the student's performance on such criteria as (a) ability to organize time, set priorities, and accomplish assigned tasks, (b) proficiency in conducting classes, drill, and physical training, and (c) performance in classrooms, field problems, and training situation. An outline of the military development scores are listed below along with their numerical equivalent.

O (Outstanding)	= 6
S+ (Above average)	= 5
S (Average or satisfactory)	= 4
S- (Below average)	= 3
M (Marginal)	= 2
U (Unsatisfactory)	= 1

The arithmetic mean of the available scores was computed and this score termed "WOCMDC Military Development Grade."

PHASE 2 - OFFICER AND WOC STUDENT GRADES DURING FLIGHT TRAINING

Flight Military Development Grades - Following WOCMDC, WOCs continue to be given military development grades for ten weeks of flight training (2 weeks of preflight and 8 weeks of primary). These scores are identical to the six WOCMDC military development grades and were computed in the same way. These grades were termed "Flight Military Grades."

Academic Grades During Flight Training - During the 34 weeks of flight training, each student attends classes in many subjects designed to prepare the student to become an Army aviator. These subjects include such topics as: Aerospace medicine; survival, escape, resistance, and evasion; aircraft maintenance; and military tactics. In the various IERW

program changes over the 5 year period of evaluation, there have generally been 20 to 23 separate topics presented in academic training, each being taught from 1 to 40 hours. At the end of the formal instruction, a test is given and the score obtained is recorded as the student's performance for that topic. These academic grades range from a minimum grade of 70 to a maximum of 100. A student who fails to make a grade of 70 or above may, under certain circumstances, be given the opportunity to retake the test. If the student made 70 or above on the retake, a grade of 70 is entered for that academic exam. A grade of 70 generally means that a student failed the first attempt of the exam and made some grade above that on the re-examination. Also, a grade of 70 was entered if a student was recycled through the entire stage and then made a passing grade on the re-examination.

During the July 1974 to July 1979 timeframe there have been numerous changes to the academic curriculum. Topics have changed, hours of instruction for certain topics have changed, often several times in one 12 month period. In general, however, the same topics have been taught in the same phase (primary, transition, instruments, night, tactics) no matter what the topic change and/or hours of instruction changes. It is assumed that the academic grade is a qualitative estimate of the general level of information processing capability of each student. Following this assumption, the academic grade is not adjusted for the exact number of hours that topic is covered in a particular curriculum. Each POI during the study period was reviewed and the academic topic placed in the correct phase of training, i.e., those that were associated with primary were placed in the primary phase, those associated with instruments were placed in the instrument phase, etc. These grades were then averaged to yield one score per student for each composite stage: Primary, transition, instrument, and tactics. This grade was termed "Academic average."

Flight Performance Grades (IP putup, checkride, and stage) - All students, officers, and WOCs receive the same flight training. However, over the time period of the study (July 1974 through July 1979) there have been five major flight training curricula (see Table 3). These programs differed in number of stages and number of hours in each stage. In order to combine and compare grades for individuals who had received training under the different programs, a common metric was developed. Four major stages of training can be seen across all programs, i.e., primary, transition, instruments, and tactics. Night training is a separate phase in the last four programs, therefore, only those who received night scores were compared on this measure. Night training for program 1 was incorporated into transition and tactics and is reflected in those grades.

Pre-solo grades are alphameric and were not included in this study. These scores were not collected and analyzed because they represent a minor part of the training and many other more meaningful comparisons are being made.

Table 4 shows how the stages in the different programs were combined. Since several stages of the original programs contained differing numbers of scheduled flight hours, a method of weighting the scores for combination was developed. The procedure can best be explained by example. Reference Table 4, it is appropriate to combine Simulator Time (ST) and Instrument Qualification (IQ) in the first program to develop a single "instrument" score. For example, assume a student received an 83 in ST and an 85 in IQ. Table 3 shows that the curriculum included 20 hours of instruction in ST and 30 in IQ.

The following formula was used to arrive at a weighted "instrument" grade:

Grade for ST		Hours in ST	
83	X	20	= 1660
Grade for IQ		Hours in IQ	
85	X	30	v = 2550
		50	4210

$\frac{4210}{50}$ = 84.2 Weighted Grade

The rationale for this procedure is to assign stage grades which are proportional to the number of training hours devoted to that aspect of the training curriculum.

The above method was followed in stages outlined in Table 4 to calculate composite stage grades for primary, transition, instruments, night, and tactics.

The same method was used to calculate weighted scores for the three flight scores a student receives in each stage:

(1) Instructor Pilot (IP) putup score.

(2) Checkride evaluation grade.

(3) Stage grade.

Overall Grade - Following completion of flight training, each graduate received an overall grade. This grade was a combination of the student's performance grades in flight and academics weighted by the number of hours of instruction in each stage. This overall grade which ranges from a minimum score of 70 to a maximum score of 100 reflects the total military, academic, and flight performance of the student.

TABLE 3

ILLUSTRATION OF FIVE MAJOR IERW CURRICULUM AND NUMBER HOURS IN EACH STAGE

JULY 1974 THROUGH JULY 1979

PROGRAM

STAGE	1	2	3	4	5
	Presolo (15 hrs)	Presolo (16 hrs)	Presolo (16 hrs)	Presolo (16 hrs)	Presolo (16 hrs)
	Primary 1 (35 hrs)	Primary (34 hrs)	Primary (34 hrs)	Primary (34 hrs)	Primary (34 hrs)
	Primary 2 (34 hrs)	Transition (25 hrs)	Transition (25 hrs)	Transition (25 hrs)	Transition (25 hrs)
	Simulator Time (20 hrs)	Basic Instruments (10 hrs)	Basic Instruments (10 hrs)	Basic Instruments (10 hrs)	Basic Instruments (10 hrs)
	Instrument Qualification (30 hrs)	Advanced Instruments (45 hrs)	Advanced Instruments (45 hrs)	Advanced Instruments (45 hrs)	Advanced Instruments (45 hrs)
	Transition (25 hrs)	Night Training (20 hrs)	Night Training (20 hrs)	Night Training (20 hrs)	Night Training (20 hrs)
	Tactics (45 hrs)	Tactics (65 hrs)	Scout Transition (10.5 hrs)	Combat Skills (60 hrs)	Combat Skills 1 (27 hrs)
			Aeroscout Training (49.5 hrs)		Combat Skills 2 (33 hrs)

TABLE 4

METHOD OF COMBINATION OF STAGES TO ARRIVE AT PRIMARY, TRANSITION, INSTRUMENT, NIGHT, AND TACTICS SCORES

ORIGINAL PROGRAMS

Composite Stage	1	2	3	4	5
Primary	Primary 1 + Primary 2	Primary	Primary	Primary	Primary
Transition	Transition	Transition	Transition	Transition	Transition
Instruments	Simulator Time + Instrument Qualification	Basic Instruments + Advanced Instruments	Basic Instruments + Advanced Instruments	Basic Instruments + Advanced Instruments	Basic Instruments + Advanced Instruments
Night	-	Night	Night	Night	Night
Tactics	Tactics	Tactics	Scout Transition + Aeroscout Tactics	Combat Skills	Combat Skills 1 + Combat Skills 2

ATTRITION EXPERIENCE

There are two basic actions taken concerning students who do not meet training requirements. They can be recycled, that is, required to repeat a stage of training or they can be eliminated from the program. Criteria for recycles and eliminations during WOCMDC can be found in the Warrant Officer Candidates Guide, 1978, Chapter 5. The standards of performance for flight training can be found in the Officer/Warrant Officer Rotary Wing Aviator Course Program of Instruction (POI). The Student Disposition Reason categories for recycles and elimination fall into five categories:

(1) Academic deficiency

(2) Medical

(3) Resignation

(4) Lack of military development

(5) Miscellaneous, i.e., death, compassionate, misconduct, AWOL etc.

For a detailed analysis of the causes of attrition in initial entry rotary wing training see Elliott, Joyce, and McMullen, 1979.

Occasionally, a student will be recycled more than one time. These may occur in the same training phase or at some other point in training. A student who is recycled more than once will be termed a multiple recycle for purposes of this report. It is also possible, although infrequent, for a student to receive more than one elimination. A student who has been eliminated for certain reason categories, e.g., medical, compassionate, etc., can apply for, and be granted, reinstatement once the problems have been resolved. These are not the only reasons for reinstatement, but are used to serve as an example of the elimination/reinstatement process. For this report, a student who was eliminated and did not reenter the program is referred to as a terminal elimination.

PHASE 3 - ATTRITION EXPERIENCE DURING WOCMDC

The number and reason categories for recycles and eliminations during the WOCMDC were obtained from the Student Information Card. Each student disposition (action and reason) is recorded on this card which is maintained on file at Fort Rucker. The number of recycles and eliminations along with the reason categories can be found in Tables 8 and 10 respectively.

PHASE 4 - ATTRITION EXPERIENCE DURING FLIGHT TRAINING

The number, stage of training, and reason categories for recycles and eliminations occurring during the flight portion of IERW training was also obtained from the Student Information Card. The action and reason categories are essentially the same as those explained above, with the exception of the inclusion of military development in the "miscellaneous" category. This was done to overcome a coding confusion between lack of military development and other miscellaneous reason categories.

RESULTS

The tables containing the specific data and analyses can be found at Appendices C through K.

PHASE 1 - STUDENT PERFORMANCE DURING WOCMDC

WOCMDC Academic Grades - WOCMDC academic grade comparisons are presented in Table 5. The mean and standard deviation (SD) are presented for each group along with the paired-t observed values (t_o), degrees of freedom (df), and the critical t value (t_c) required for significance with $\alpha = .05$ and $\beta = .2$. The t_c values are calculated using the method at Appendix B. The t_o must exceed the t_c (either direction for a two-tailed test) in order to reject the hypothesis of no differences between the minority and control group.

From Table 5, one can see that no minority group differed, significantly, from its matched control group on WOCMDC academic grades.

Military Development Grades - The data in Table 6 shows that there were no significant differences between any minority group and their MC group on average military development grade in WOCMDC. The table presents the number (N) of the pairs compared and the Wilcoxon matched-pairs signed-ranks test T (Siegel, 1956). For any of the observed N's, the Wilcoxon T must be ≤ 4 for significance at $\beta = .05$.

PHASE 2 - STUDENT PERFORMANCE DURING FLIGHT TRAINING

WOC Military Development Grades - Table 7 shows that there were also no differences in Military Development grades for WOC students during the 10 weeks of flight training in which these grades are given (Presolo + Primary). These scores represent the military development scores given to WOC students during the initial 10 weeks of flight training which follows WOCMDC. The Wilcoxon signed-rank test (Siegel, 1956) was again used. The table presents the N of the pairs, the average military development grade for each group, and the T-value calculated. The computational procedure required for the Wilcoxon signed-rank test calls for the ranking of the scores. The black group and their MC's had only two pairs with military development scores, thus, a statistical significance test would have little meaning. Therefore, this comparison was not made.

TABLE 5

Comparison of WOC minorities and their matched controls on average academic grade during WOCMDC.

STAGE = WOCMDC

PERFORMANCE MEASURE = AVERAGE ACADEMIC GRADE

GROUP	MEAN	SD	df	t_o	t_c
BLACK	83.8	2.28	4	.45	>|3.18|
MATCHED CONTROL	85.2	6.26			
HISPANIC	82.9	4.97	10	.87	±2.97
MATCHED CONTROL	84.9	4.50			
ASIAN	85.4	3.78	4	-.21	>|3.18|
MATCHED CONTROL	84.8	3.03			
AMERICAN INDIAN	85.4	3.88	8	2.57	±3.02
MATCHED CONTROL	88.4	2.01			
FEMALE	86.11	6.37	8	-.55	±3.02
MATCHED CONTROL	84.55	5.61			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE 6

Comparison of minority WOCs and their matched controls on WOCMDC average Military Development Grade

GROUP	N	$\bar{X}$ MIL DEV GRADE	WILCOXON T*
BLACK	6	3.0	6.5
MC	6	3.71	
HISPANIC	8	3.87	11.5
MC	8	4.25	
ASIAN	6	4.00	6.5
MC	6	4.12	
INDIAN	7	4.28	13.0
MC	7	4.14	
FEMALE	8	3.62	16.5
MC	8	3.37	

*WILCOXON T scores must be $\leq$ 4 for significance at α = .05.

ACADEMIC AND FLYING PERFORMANCE GRADES

ACADEMIC GRADES - Comparisons of minority groups with their MCs on academic grades by stage of training can be found at Appendix E. The paired-t statistic was again used to test for differences between the minorities and their MCs. Tables E1 through E5, Appendix E show that all but one of these comparisons revealed no significant differences. The data shown in Table E1, however, reveals that Blacks primary academic grades were significantly (t_o = 3.37, α = .05, β = .2) lower than the grades of their MC group.

TABLE 7

Comparison of minority WOCs and their matched controls on average military development grades during the flight portion of IERW.

GROUP	N	$\bar{X}$ MIL DEV GRADE	WILCOXON T[a]
BLACK	2	4.5	b
MC	2	4.5	
HISPANIC	8	4.5	12.5
MC	8	4.7	
ASIAN	4	5.2	3.5
MC	4	5.2	
INDIAN	6	5.3	6.5
MC	6	5.2	
FEMALE	6	4.5	6.0
MC	6	4.8	

[a]WILCOXON matched pairs T, with above Ns, must be $\leq$ 2 for significance at $\alpha = .05$.

[b]Significance test not appropriate with N = 2

FLIGHT PERFORMANCE GRADES - Comparisons of minority groups with their matched control groups on IERW flight grades are shown in Appendix F, Tables F1 through F15. These Tables present, successively, comparisons between each minority and their matched control groups across three performance measures (IP putup grade, checkride evaluation grade, and stage grade) for each of five stages of flight training (primary, transition, instruments, night, and tactics). Each table presents the mean

grades, their standard deviations, the paired-t statistics degrees of freedom, observed t value (t_o), and the critical t (t_c) value required for significance with $\alpha = .05$ and $\alpha = .2$. The results of the analyses presented in these tables indicate no differences in flight grades, IP putup grade, checkride grade, or stage grade, were found for any minority group, as compared to their MC, across any stage of flight training.

The comparisons of night flight training grades included only those students who received a night grade, therefore, the number of subjects available for these comparisons are smaller than the number for the other stages. Night flight training, as a separate stage, was developed for the 175/40 program and only those students receiving training under this program received night flight training scores. Night flight training was included in the transition and tactics grades of training programs prior to the 175/40 program. It was not possible to separate this component of those grades, therefore, only those students in the 175/40 program were used in the night grades comparison.

The performance scores (IP putup, checkride, and stage) across the stages represent scores of those students who were considered proficient enough to be "put up" for a checkride evaluation. Students who received a large percent of the training required for a particular stage, but never reached a level of proficiency such that the IP felt he (the student) could pass a checkride, was either recycled or eliminated prior to receiving grades for that stage. Therefore, most of the IP putup, checkride evaluations, and stage grades reflect the performance of students who have passed that stage of training. In rare instances a student will be putup for a checkride by the IP, but fail the checkride and thus receive an unsatisfactory grade. These grades would be recorded as a "U" until the student received more training and then was again given a checkride. If the student received <u>any</u> passing grade on the second checkride, a maximum score of 70 would be entered as the checkride and stage grade. A student who failed the second checkride would be recycled or eliminated.

IERW OVERALL GRADE - Table 8 presents the comparison of minority groups and their matched control groups on IERW overall grade. The paired-t t_c was developed using the procedure and power tables outlined in Appendix B. The overall grade used for these comparisons was calculated with the procedure used by the Directorate of Training, Fort Rucker, at the time the student attended IERW training. The results presented in Table 8 indicate none of the minority groups differed significantly from their matched control group on IERW overall grade. Again, to point out the obvious, only those students successfully completing the IERW program receive an overall grade.

PHASE 3 - ATTRITION EXPERIENCE DURING WOCMDC

Table 9 presents the cause and number of recycles during WOCMDC. Each minority group's recycles are presented in the upper section of the table with the matched controls in the lower section. The first

TABLE 8

Comparison of minority groups with matched control groups on IERW overall grade. Jul 74 through Jul 79.

STAGE = ALL

PERFORMANCE MEASURE = OVERALL GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	85.02	2.59	30	2.29	±2.85
MATCHED CONTROL	86.37	2.59			
HISPANIC	85.14	2.0	27	2.66	±2.86
MATCHED CONTROL	86.46	2.24			
ASIAN	86.66	1.7	10	.21	±2.97
MATCHED CONTROL	86.87	2.63			
AMERICAN INDIAN	85.65	2.55	21	1.70	±2.88
MATCHED CONTROL	86.84	2.96			
FEMALE	85.68	2.95	23	.75	±2.87
MATCHED CONTROL	86.23	3.15			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

column shows the reason for the recycle. Subsequent columns show the number of first, second or third recycles occurring due to each reason category. For example, a female student received two recycles both for military development reasons. Recycles falling into the miscellaneous reason category include administrative categories, AWOL, and compassionate reasons. It can be seen from this table that very few recycles occurred for any group, minority or matched control. Table 9 also shows that the majority of recycles were for medical or military development deficiencies.

The data shown in Table 10 illustrates the comparison of minorities and their MCs on number of individuals recycled during WOCMDC. The table presents the N and number of recycles for each minority group and MC group, the recycle proportions, and the z-score[5] of the difference between the minority and its MC. The proportion test z-scores must be ≥ 1.96 for significance with $\alpha = .05$. It can be seen that only one of the comparisons reach the z-score required for significance. Hispanic WOCMDC student received significantly more recycles than did their MC group.

Appendix G, Figures G1 through G10, trace the flow of WOCMDC students in terms of recycles and eliminations. Each minority group and its matched control group are shown in separate figures. These figures show the number of students entering WOCMDC in the identified category (Black, MC for Black, Asian, MC for Asian, etc). The flow of students through the WOCMDC is illustrated by the various ways in which students progress through the program, e.g., no recycles or eliminations, with recycles, with recycles and eliminations. Further, the recycles are traced according to the outcome following the recycle, i.e., eliminated or graduating. Some students who are eliminated, either following a recycle or not, are reinstated and continue in the course. It should be noted that some students are eliminated without being previously recycled. There are a variety of reasons for reinstating a student who has been eliminated. For example, a student experiencing financial or personal difficulties that prevent him from maintaining performance standards can be allowed to re-enter the WOCMDC course when the problem has been resolved. Also illustrated in Figures G1 through G10 is the number of students in each group receiving reinstatements. The total number of students completing WOCMDC is shown in the final block.

These figures are presented to illustrate student flow through the WOCMDC program. Eliminations during WOCMDC are shown in Table 11. The number of eliminations by reason category and group (minority or MC) are listed by the order of eliminations received. For example, one female student was eliminated twice. Both eliminations were for medical reasons. The number in parentheses under the "1st elimination" column represents the number of students eliminated and represents the number of students who did not graduate.

---

[5]Use of the proportions test for testing differences in attrition prevents generalizing the findings to other than the tested groups.

TABLE 9

STATED CAUSE AND NUMBER OF RECYCLES DURING WOCMDC

# RECYCLES =	BLACK N=30 1st	2nd	3rd	HISPANIC N=30 1st	2nd	3rd	ASIAN N=15 1st	2nd	3rd	INDIAN N=20 1st	2nd	3rd	FEMALE N=27 1st	2nd	3rd
REASON															
ACADEMICS															
MEDICAL	1	1		2						1			4		
RESIGNATION															
MILITARY DEVELOPMENT	4			2			1	2					1	1*	
MISCELLANEOUS	1	1	1	2			1		1						
TOTALS	(6)	2	1	(6)			(2)	2	1	1			(5)	1	
TOTAL NUMBER OF STUDENTS RECYCLING	6			6			2			1			5		
PERCENT OF STUDENTS RECYCLING	20%			20%			13%			5%			19%		

# RECYCLES =	MATCHED CONTROL N=30 1st	2nd	MATCHED CONTROL N=30 1st	2nd	MATCHED CONTROL N=15 1st	2nd	MATCHED CONTROL N=20 1st	2nd	MATCHED CONTROL N=27 1st	2nd
ACADEMICS										
MEDICAL							1	1		
RESIGNATION										
MILITARY DEVELOPMENT	2				2				2	
MISCELLANEOUS										
TOTALS	(2)		0		(2)		(1)	1	(2)	
TOTAL NUMBER OF STUDENTS RECYCLING	2		0		2		1		2	
PERCENT OF STUDENTS RECYCLING	7%		0		13%		5%		7%	

*This student received more than one recycle.

TABLE 10

Comparison of minorities and their matched controls on number of recycles during WOCMDC.

GROUP	N	# RECYCLES	PROPORTION OF RECYCLES	Z SCORE OF DIFFERENCE BETWEEN MIN AND MC
BLACK	30	6	.20	1.51
MC	30	2	.067	
HISPANIC	30	6	.20	2.58*
MC	30	0	0	
ASIAN	15	2	.067	0
MC	15	2	.067	
INDIAN	20	1	0	0
MC	20	1	0	
FEMALE	27	5	.185	1.21
MC	27	2	.074	

Proportion test z scores required to be $\geq |1.96|$ for significance at $\alpha = .05$.

*Significant at the $\alpha = .05$ level

TABLE 11

STATED CAUSE AND NUMBER OF ELIMINATIONS DURING WOCMDC

# OF ELIMINATIONS*	BLACK N=30 1st	BLACK N=30 2nd	HISPANIC N=30 1st	HISPANIC N=30 2nd	ASIAN N=15 1st	ASIAN N=15 2nd	INDIAN N=20 1st	INDIAN N=20 2nd	FEMALE N=27 1st	FEMALE N=27 2nd
REASON										
ACADEMICS									1	1
MEDICAL							1		1	
RESIGNATION	2	1								
MILITARY DEVELOPMENT	5		1				1		2	
MISCELLANEOUS										
TOTALS	(7)	1	1		(0)		(2)		(4)	1
TOTAL NUMBER OF STUDENTS ELIMINATED	7		1		0		2		4	
PERCENT OF STUDENTS ELIMINATED	23%		7%		0		10%		15%	
# ELIMINATIONS =	MATCHED CONTROL N=30 1st	MATCHED CONTROL N=30 2nd	MATCHED CONTROL N=30 1st	MATCHED CONTROL N=30 2nd	MATCHED CONTROL N=15 1st	MATCHED CONTROL N=15 2nd	MATCHED CONTROL N=20 1st	MATCHED CONTROL N=20 2nd	MATCHED CONTROL N=27 1st	MATCHED CONTROL N=27 2nd
ACADEMICS										
MEDICAL	1	1	1							
RESIGNATION					1				2	
MILITARY DEVELOPMENT	2				1					
MISCELLANEOUS									1	
TOTALS	(3)	1	(1)	0	(2)	0	(0)	0	(3)	0
TOTAL NUMBER OF STUDENTS ELIMINATED	3		1		2		0		3	
PERCENT OF STUDENTS ELIMINATED	10%		3%		13%		0		11%	

*Some students have more than one elimination. These students were reinstated for a variety of reasons, then again eliminated.

Using the data taken from Figures G1 through G10, the test of differences of proportions between each minority group and its matched control is presented in Table 12. The number of eliminations used for these comparisons represent those students who were eliminated (not reinstated) thus did not complete the WOCMDC program, e.g., terminal eliminations. The number of eliminations and associated proportion of N along with the z-score is presented. The z-score necessary to attain significance with $\alpha = .05$ is ± 1.96. It can be seen from Table 12 that none of the calculated z-scores exceed this value, therefore, no differences were found between minority groups and their matched controls in the area of WOCMDC eliminations.

PHASE 4 - ATTRITION EXPERIENCE DURING FLIGHT TRAINING

Appendix H, Figures H1 through H10 indicate the flow of students through the flight portion of IERW training. The first block indicates the number of students, officers and WOCs entering flight training. The figure identifies the number of students who are recycled and eliminated, as well as the total number of students completing flight training. A student can be eliminated, and then reinstated in the program. Reinstatement can sometimes be obtained if the elimination was due to a temporary problem (financial, medical, personal) that has been resolved. None of the students used for this evaluation received more than one elimination during flight training.

Figures E1 through E11, Appendix E, are presented to illustrate the attrition process for each group (minority and MC) and to be used to develop data to be used later for statistical comparisons.

Tables I1 through I5, Appendix I, illustrate the total number of recycles of each group (minority and MC) across the different stages of IERW flight training. The totals for each group represent the number of recycles and not individuals. That is, a person who received a recycle in primary and in instruments would be counted as a recycle in both stages. This procedure was adopted in order to illustrate the phases of flight training in which recycles occurred. The N's displayed in the upper right hand corner of the tables represent the number of students entering primary only. Losses of students occurs during several stages, therefore, the number of students reaching the tactics stage will be somewhat less than the number beginning primary. These tables show that the primary and instrument stages produce the greatest number of recycles for most minorities and MCs. This is consistent with the findings by Elliot, Joyce, and McMullen, 1979. Little difference can be seen between minorities and their MCs across IERW training stages with the exception of recycles during primary for Blacks, Hispanics, and females, all having higher incidences of recycles during primary than their MCs. The recycle rates across all groups is highest during the instrument phase of training.

TABLE 12

Comparison of minorities and their control groups on number of eliminations during WOCMDC.

GROUP	N	# ELIMINATIONS	PROPORTION OF ELIMINATIONS	Z SCORE OF THE DIFFERENCE BETWEEN MIN AND CONTROLS
BLACK	30	7	.23	1.35
MC	30	3	.10	
HISPANIC	30	1	.033	0
MC	30	1	.033	
ASIAN	15	0	0	-1.42
MC	15	2	.13	
INDIAN	20	2	.10	1.45
MC	20	0	0	
FEMALE	27	4	.148	.40
MC	27	3	.111	

Proportion test z score required to be $\geq |1.96|$ for significance at $\alpha = .05$

The number and causes of recycles during IERW flight training is presented in Table 13. The Table shows the number of recycles in each reason category by group, (minority across the top with the MCs across the bottom). For a description of the reason categories see Student Disposition in the Glossary of Terms, Appendix A.

Also displayed for each group is the number of 1st, 2nd, and 3rd recycles in each reason category. For instance, 25 Blacks were recycled. Ten (10) of these were recycled for flight deficiencies. Thirteen of the 25 Blacks who had one recycle, also received a 2nd recycle. Six of these 13 were recycled for flight deficiencies. Three of the 13 who received a 2nd recycle were also given a third recycle, all for flight deficiencies.

TABLE 13

CAUSES AND NUMBER OF RECYCLES DURING THE FLIGHT PORTION OF IERW TRAINING

REASON	BLACK N=51 RECYCLES 1st	2nd	3rd	HISPANIC N=45 RECYCLES 1st	2nd	3rd	ASIAN N=18 RECYCLES 1st	2nd	3rd	INDIAN N=27 RECYCLES 1st	2nd	3rd	FEMALE N=38 RECYCLES 1st	2nd	3rd
ACADEMICS	1	1											1		
FLIGHT	10	6	3	13	1		3			3	2		4	2	1
MEDICAL	10	3		3	1					5	1		6	4	1
MISCELLANEOUS	4	3		3									3		
TOTALS	(25)	13	3	(19)	2	0	(3)	0	0	(8)	3		(14)	6	2
TOTAL STUDENTS RECYCLED	25			19			3			8			14		
PERCENT OF STUDENTS RECYCLED	49%			42%			17%			30%			37%		
REASON	MATCHED CONTROL N=54 RECYCLES 1st	2nd	3rd	MATCHED CONTROL N=45 RECYCLES 1st	2nd	3rd	MATCHED CONTROL N=17 RECYCLES 1st	2nd	3rd	MATCHED CONTROL N=29 RECYCLES 1st	2nd	3rd	MATCHED CONTROL N=39 RECYCLES 1st	2nd	3rd
ACADEMICS															
FLIGHT	11	2	1	6	2		1			3	3		7	1	
MEDICAL	3	1	1	1	1					1	1		3		
MISCELLANEOUS		1				1		1		2					
TOTALS	(14)	4	2	(7)	3	1	(1)	1	0	(6)	3	1	(10)	1	0
TOTAL STUDENTS RECYCLED	14			7			1			6			10		
PERCENT OF STUDENTS RECYCLED	26%			16%			6%			21%			26%		

Table 14 shows the comparison of minorities and MCs on number of individuals recycled during IERW flight training. For these comparisons each individual who was recycled was counted only once as a recycle. A proportion test was used to test for differences between each minority group and its matched control. A proportion test z-score of $\geq |1.96|$ is required for significance with $\alpha = .05$. It can be seen that both Blacks and Hispanics received significantly more recycles than did their MC groups (z-scores of 2.44 and 2.78 respectively). None of the other minorities differed significantly from their MC. This finding supports the observation of differences between Blacks and Hispanics and their MCs when total number of recycles were counted (see Appendix G).

TABLE 14

Comparison of minorities and their matched controls on number of recycles during IERW flight training. Jul 74 through Jul 79.

GROUP	N	# RECYCLES	PROPORTION OF RECYCLES	Z SCORE OF DIFFERENCE BETWEEN MIN AND MC
BLACK	51	25	.49	2.44*
MC	54	14	.26	
HISPANIC	45	19	.422	2.78*
MC	45	7	.156	
ASIAN	18	3	.17	.33
MC	17	1	.06	
INDIAN	27	8	.30	.93
MC	29	6	.21	
FEMALES	38	14	.368	1.06
MC	39	10	.256	

*proportion test z significant at $\alpha = .05$

z score $\leq |1.96|$ needed for significance with $\alpha = .05$

The data in Table 15 shows the cause and number of eliminations during IERW flight training by group. The number of eliminations by reason category is also shown for each group with the minority groups across the top, their MCs across the bottom. The TOTAL's row indicates the total number of eliminations for all reason categories and the number of eliminations. The number in parenthesis represents the total number of eliminations in each group. Some of the eliminees may have been reinstated and subsequently completed the flight program. A description of the reason categories can be found in the Glossary of Terms under Student Dispositions.

The number of eliminations for each minority group and MC across IERW stages is presented in Appendix J, Tables J1 through J5. Again, these tables are designed to illustrate the stages of training in which eliminations occur.

It can be seen from these tables that most eliminations occurred in instruments with primary being next highest. The tables show that few students are eliminated in transition, night, and tactics.

Table 16 presents the comparison of minorities and their MCs on number of eliminations during the flight portion of IERW training. The table shows the number of students entering flight training by group, the number of these students who were eliminated, the proportion of eliminations, and the proportions test z-score. The proportions test z-score must be $\geq |1.96|$ in order to be significant at $\alpha = .05$. The table shows that the Black group received significantly more eliminations (z-score = 2.08) than did their MCs. No other minority group differed significantly from its MC.

Table 17 shows the comparison of minorities and their matched controls on number of individuals receiving multiple recycles during flight training. The table presents each group, the total number of recycles for that group, the number of individuals who were recycled more than once, the proportion of multiple recycles for each group, and the proportion test z-score. The z-score requirement for significance at $\alpha = .05$ is $\leq |1.96|$. The data from table 15 shows that none of the comparisons were significant.

An illustration of the differences between officer and WOC attrition during IERW flight training is shown in Appendix K, Figure K1 through K5. These figures trace the flow of students through the possible avenues of attrition during IERW. The first block shows the number of officers and WOC's entering the flight portion of IERW. The intervening blocks show the number of students who are recycled and eliminated by various methods. The last block represents the number of students who successfully completed the IERW program. It can be seen from these figures that the difference in attrition between officers and WOCs is not great with the exception of the Black WOCs.

TABLE 15

STATED CAUSE AND NUMBER OF ELIMINATIONS* DURING THE FLIGHT PORTIONS OF IERW TRAINING

REASON	BLACK ELIMS N=51	HISPANIC ELIMS N=45	ASIAN ELIMS N=18	INDIAN ELIMS N=27	FEMALE ELIMS N=38
ACADEMICS					
FLIGHT	9	2	3	1	
MEDICAL	1	4			1
RESIGNATION		3			1
MISCELLANEOUS	1				2
TOTALS	(11)	(9)	(3)	(1)	(4)
TOTAL NUMBER OF STUDENTS ELIMINATED	11	9	3	1	4
PERCENT OF TOTAL STUDENTS THAT WERE ELIMINATED	22%	20%	17%	4%	11%
	MATCHED CONTROLS N=54 ELIMS	MATCHED CONTROLS N=45 ELIMS	MATCHED CONTROLS N=17 ELIMS	MATCHED CONTROLS N=29 ELIMS	MATCHED CONTROLS N=39 ELIMS
ACADEMICS					
FLIGHT	2	3	2	1	2
MEDICAL	1	1			
RESIGNATION	1	1	1	1	1
MISCELLANEOUS		1	1		
TOTALS	(4)	(6)	(4)	(2)	(3)
TOTAL NUMBER OF STUDENTS ELIMINATED	4	6	4	2	3
PERCENT OF TOTAL STUDENTS THAT WERE ELIMINATED	7%	13%	24%	7%	8%

*The number of eliminations in this table may be greater than the number of terminal eliminations. Some students are eliminated, then reinstated and completed the flight program. The numbers here represent all eliminations and their causes regardless of final disposition.

TABLE 16

Comparison of minorities and their matched controls on number of eliminations during IERW flight training. Jul 74 through Jul 79.

GROUP	N	# ELIMINATIONS	PROPORTION OF ELIMINATIONS	Z SCORE OF DIFFERENCE BETWEEN MIN AND MC
BLACK	51	11	.216	2.08*
MC	54	4	.074	
HISPANIC	45	9	.200	.84
MC	45	6	.133	
ASIAN	18	3	.167	-.48
MC	17	4	.235	
INDIAN	27	1	.037	-.53
MC	29	2	.069	
FEMALES	38	4	.105	.43
MC	39	3	.077	

*proportion test z significant at $\alpha = .05$

z score of $\leq |1.96|$ needed for significance at $\alpha = .05$

TABLE 17

Comparison of minorities and their MC groups on number of multiple recycles during IERW flight training.

GROUP	TOTAL # RECYCLES	# STUDENT RECEIVING MORE THAN 1 RECYCLE	PROPORTION OF MULTIPLE RECYCLES	Z SCORE OF DIFFERENCE BETWEEN MINORITY AND MC
BLACK	25	13	.52	1.45
MC	14	4	.28	
HISPANIC	19	2	.10	-1.89
MC	7	3	.43	
ASIAN	3	0	0	Not tested
MC	1	1	1.00	
INDIAN	8	3	.37	-.49
MC	6	3	.50	
FEMALE	14	6	.43	1.75
MC	10	1	.10	

z score of $\geq |1.96|$ required for significance at $\alpha = .05$

Table 18 shows the comparison of WOCs and officers on elimination rates. This shows that the Black WOCs had significantly more eliminations than did the Black officers ($z = -2.58$ at $\alpha = .05$). No other minority group had any significant differences in eliminations between officers and WOCs.

TABLE 18

Comparison of officers and WOCs on elimination rate.

GROUP		N	# ELIMINATED	% ELIMINATED	Z SCORE OF DIFFERENCE BETWEEN OFF AND WOC
BLACK	OFF	27	2	.074	-2.58**
	WOC	24	9	.375	
HISPANIC	OFF	16	2	.12	-.96
	WOC	29	7	.24	
ASIAN	OFF	3	0	0	-.84
	WOC	15	3	.20	
INDIAN	OFF	9	0	0	-.64
	WOC	18	1	.05	
FEMALE	OFF	15	1	.07	-.60
	WOC	23	3	.13	

**Significant at $\alpha<.001$

Proportion test z score required for significance at $\alpha = .05$ is $\leq |1.96|$

DISCUSSION

The comparisons of the minority groups with their matched control groups showed that there were no significant differences on the matching variables (FAST, GT, Age, and Education Level). However, when the minority groups were compared with the total majority group several important differences were revealed:

(1) Black officers had significantly lower FAST scores;

(2) Female WOCs had significantly lower FAST scores;

(3) Hispanic WOCs had significantly lower GT scores;

(4) Hispanic WOCs also had a significantly higher age level.

These differences suggest that these minority groups do not represent the "typical" IERW student. Finding differences between minority and majority groups on entry level tests is not unique to this study. Baisden and Doll (1978) compared the selection test scores of Black Naval aviation trainees with the average scores for all naval aviation trainees and concluded, "Clearly, the samples under study... (Black Naval aviation trainees plus a matched group of white trainees)... represent the lower end of the Academic Qualification Test/Flight Aptitude Rating (AQT/FAR) score continuum." This suggests that, if the FAST and GT tests relate to performance in flight training, Blacks, Hispanics, and Females may experience more difficulty in acquiring flying skills than would the typical IERW student. One might expect these minority groups' performance scores to be lower and attrition rates to be higher than the typical student. This, however, by no means is indicative of an expected difference between the minority group and its matched control group. It must be remembered that the MCs and minorities were matched based on FAST, GT, Class, Educational level, Age, and Source of entry. Therefore, differences in these entry level skills between the minority and MC should be at a low level.

PHASE 1 - STUDENT PERFORMANCE DURING WOCMDC

No significant differences were found between any minority group and their MC in either WOCMDC academic grades or military development grades. These findings indicate that there are no performance differences between minority Warrant Officer Candidates and majority candidates.

PHASE 2 - OFFICER AND WOC STUDENT PERFORMANCE DURING FLIGHT TRAINING

Flight Military Development Grades - The comparison between minority groups and their MC groups also failed to show any significant differences for military development grades during flight training. The average military development grade for each group, minority and MC, was higher during flight training than during WOCMDC. The average military development grade

during WOCMDC ranged from 3 (below average) to 4 (average), while the average score during flight training ranged from 4 (average) to 5 (above average). This difference is probably due to: (1) a relaxation of the rigorous WOCMDC standards to allow the student more time to concentrate on flight training, and (2) the student adapting to and learning the military development requirements.

Academic and Flying Performance Grades

Academic Grades - The comparisons between minority groups and their MC groups across IERW training stages showed that the only significant difference observed was the Black group during the Primary stage. None of the other comparisons were significant. The Black group had a mean Primary academic grade of 85.27. The MC for the Black group had a mean grade of 88.36. This finding, however, must be judged in relationship to attrition information. For example, even though Blacks received lower academic scores, there was only one student who was recycled for academic reasons and there were no eliminations during flight training for academic reasons. These results show that the academic requirements are, for the most part, being met by both minority and majority students. They also show that the group with the lowest average academic scores (Blacks) are well within the acceptable standards of performance even though their scores were significantly lower than those of their MC.

Flight Performance Grades - The comparisons between minority groups and their MCs on flight grades (IP putup, checkride, and stage grades) revealed no significant differences across any stage of training (Primary, Transition, Instruments, Night, or Tactics). It must be understood that, in most cases, these comparisons were made with students who had reached a sufficient proficiency level for the student's IP to recommend that he/she take the end of stage checkride. Usually, a student is not put up for a checkride if he/she has demonstrated marginal or unsatisfactory performance. A student who was recycled and received more training would not be given the end of stage checkride until he/she had reached an acceptable performance level, even if several recycles were required. For these reasons, a very few students who performed unsatisfactorily did not receive stage grades until their performance had improved.

Students who never reach an acceptable level of performance are eliminated prior to receiving a checkride or stage grade. Therefore, IP putup, checkride, and stage grades are most often given only for successful performance regardless of the amount of training required to reach proficiency on the criterion measures. Therefore, the comparison of IP putup, checkride evaluations, and stage grades are fairly gross measures of performance and do not reflect possible subtle performance differences. These comparisons, however, should be sensitive enough to determine if IP put minority students up for checkrides with lower scores, although still passing, or if checkride IPs give lower, although still passing, grades to minority students. Neither of these possible mechanisms of discrimination was shown in the data. There were no significant differences between any minority group and its MC

on either IP putup grades or checkride grades. This finding indicates that grades of students who reach an acceptable level of performance do not differ significantly. It is unlikely that sexual or ethnic discrimination would be seen for some members of a minority and not others (unsuccessful vs successful students). The implication is that minority students do not receive lower grades based on their being members of a minority.

Overall Grade - There were no significant differences between any minority group and its MC group on overall grade. Again, it must be understood that only students who graduate from flight training receive an overall grade.

PHASE 3 - ATTRITION EXPERIENCE DURING WOCMDC

The comparisons between minority groups and their MCs for recycles showed only one group (Hispanics) to have received significantly more recycles than their MC. These recycles were spread evenly over three categories, i.e., Medical = 2, Military Development = 2, and Miscellaneous = 2. Again, the small N's associated with these comparisons (Hispanics - 6 recycles in 30 students, and MC - 0 recycles in 30 students) makes interpretation difficult. Further research is needed to ensure this difference is consistent over time and to investigate the underlying causes. The majority (80 - 90%) of the recycles were for medical or military development reasons. (Thirty-eight (38%) percent of the minorities and 20% of the MC's recycles occurred for medical reasons. Forty-six (46%) percent of minority and 80% of the MC recycles were for military development reasons). The information necessary to understand what the medical and military development reasons were and why they occurred was not collected as a part of this study.[6] Elliott, Joyce, and McMullen (1979) also found more eliminations than recycles during WOCMDC. It is not entirely clear why this occurred. It is probably related to administrative policies and procedures in existence at the aviation school. Again further research into the causes of attrition is indicated. The comparison of eliminations shows that there are no differences between any minority and their MC group.

The Black group had the lowest success rate for WOCMDC, but still had 80% completing the course. The female group was next with 85% completing WOCMDC. These results suggest that a large percentage of the WOCMDC students are eventually successful regardless of ethnic or sex status and that pervasive discrimination cannot be supported.

PHASE 4 - ATTRITION EXPERIENCE DURING FLIGHT TRAINING

The comparisons of minority groups and their MCs show that both Blacks and Hispanics received significantly more recycles than did their counterpart MCs. No other group differed significantly. However, the Black, Indian, and Female groups had a large proportion of recycles for medical and miscellaneous reasons (Blacks - 56%, Indian - 63%, Female - 64%). Miscellaneous recycles can occur for events such as emergency leave, loss of flight time

---

[6]The reader is referred to Elliott, Joyce, and McMullen, 1979, and Roth, 1980 for an analysis of the causes of attrition in IERW training.

due to poor weather conditions, compassionate reasons, etc. These kinds of recycles are generally self-initiated actions on the part of the student and are not imposed upon them by the training center. With the exception of the Asian group, all minority groups received less recycles for flight deficiencies than did their MCs. The implication of this finding is that medical and miscellaneous factors, not flight deficiencies create most of the recycles for minority students.

Only the Black group received more terminal eliminations than did their MC group ($z = 2.08$). This finding, however, should be considered in light of the small number of eliminations that occurred (Blacks = 11 of 51 and MC = 4 of 54). A change in status of 1 or 2 people from the elimination to graduation category, or vice versa, could make the z score nonsignificant. Even with more recycles and eliminations for some minority groups, the success rate for completion of flight training was still high (78.4% for Blacks, 80% for Hispanics, 81% for Asians, 96% for Indians and 89% for females, as compared to 90.6% for all MCs).

A comparison of the number of WOCs and officers who graduate from flight training shows that 92.8% of the officers and 79% of the WOCs who entered flight training eventually graduated. This finding is somewhat contrary to the current idea that the success rate for WOCs and officers is equivalent once the WOC student completes WOCMDC. The reason for this difference is most likely due to the subjects used for this study not being representative of the total student population. It has previously been shown that the minority subjects and their MCs do not reflect the entry abilities (as measured by entry level paper and pencil tests) of the typical students. Therefore, the success rate for these groups does not appear to match the rate for most IERW students (85% completion).

The number of recycles by stage of training reflects the current expectation, e.g., Primary and Instruments produce the largest number of recycles for both minorities and MCs. The only real difference between minorities and MCs appears to occur for the Black group and their MCs in Primary. Black students received 16 recycles (1 academic, 4 flight, 8 medical, 3 other/miscellaneous) during Primary while their MCs received a single recycle.[7]

The comparison of minorities and their MCs on the number of each group receiving multiple recycles showed no significant differences even though Blacks and females appeared to have a large number of multiple recycles (52% of the Blacks and 43% of the Females who were recycled, were recycled more than once).

If systematic bias was occurring, one would expect that all or most of the minority groups to have lower performance scores and higher attrition than a group of counterpart majority students who began flight training with essentially the same entry scores/variables. This, however, was not the case for this sample of students. No minority group had lower flight grades, only one had lower academic grades, and that difference was not a practical

---

[7]The number of recycles used here reflects the total number of recycles and the number of individuals recycled. If a single student was recycled more than once, each recycle was counted.

difference. The attrition area was the only area in which practical differences were indicated and then only for the Black and Hispanic groups. However, a large portion of the attrition for these groups was "self-initiated," e.g., medical, compassionate, etc. The amount of flight deficiency eliminations was relatively the same for all groups except the Black group. The Black group did experience more eliminations due to flight deficiency than did their MCs. However, the number of eliminations for flight deficiencies (9 for Blacks and 2 for the MCs) was so small that a change of 1 or 2 people from one category to the other would make the difference nonsignificant.

RECOMMENDATIONS

1. A computerized data base be developed for flight performance record keeping. It was necessary to hand search over 4,000 flight records to accomplish this study. A computerized data base would have considerably shortened the time required to complete the data collection.

2. USAAVNC evaluate the current grading system to determine its effectiveness in meeting present objectives. This study suggests that differences in performance between students cannot be readily observed using IP putup, checkride, or stage grades. These grades have considerable restriction in range and variability.

3. A further evaluation of the WOCMDC should be accomplished to examine the cause(s) of medical and military development deficiencies leading to attrition.

4. A further evaluation of Primary academics be performed to validate that the differences are consistent over time and to determine reasons for these differences and to determine what additional instruction and/or changes in instruction would be appropriate.

5. A further evaluation of the reasons for medical recycles and eliminations during flight training be conducted. A better method of reporting medical causes for recycles and eliminations would improve USAAVNC awareness of the problems.

REFERENCES

Baisden, A. G. and Doll, R. E. *A comparison of black student performance and white student performance in naval aviation.* Pensacola, Florida: Naval Aerospace Medical Laboratory, Special Report 78-7, November 1978.

Baisden, A. G. and Doll, R. E. *A comparison of college background, pipeline assignment, and performance in aviation training for black student naval aviators and white student naval aviators.* Pensacola, Florida: Naval Aerospace Medical Laboratory Special Report, November 1979.

Bruning, J. L. and Kintz, B. L. *Computational handbook of statistics,* (2nd ed). Glenview, Illinois: Scott, Foresman and Co., 1977.

Cohen, Jacob *Statistical power analysis for the behavioral sciences.* New York, NY: Academic Press, 1977.

Dohme, J. A. *Evaluation of FAST, GT, MM and GM scores.* Unpublished paper, Army Research Institute, Fort Rucker Field Unit, 1978.

Doll, R. E. and Baisden, A. G. *A comparison of black civilian procured applicants and white civilian procured applicants for naval aviation training - CY 1976 - 1978.* Pensacola, Florida: Naval Aerospace Medical Laboratory, Special Report 79-3, May 1979.

Eastman, R. F. and McMullen, R. L. *The current predictive validity of the flight aptitude selection test.* Fort Rucker, Alabama: Army Research Institute Research Report 78-2, March 1978.

Elliott, T. K., Joyce, R. P., and McMullen, R. L. *The causes of attrition in initial entry rotary wing training.* Fort Rucker, Alabama: US Army Research Institute, ARI Technical Report No. TR-79-B1, January 1979.

Guion, Robert M. *Recruiting, selection, and job placement.* In Dunnette, M.D. (Ed.), Handbook of Industrial and Organizational Psychology. Chicago, Illinois: Rand McNally College Publishing Co., 1976.

Hays, W. L. *Statistics.* New York: Holt, Rinehart, and Winston, 1963.

Nie, N. H., Hull, C. H., Jenkins, J. G., Stienbrenner, K., and Bent, D. H. *Statistical package for the social sciences* (2nd Ed). New York: McGraw-Hill, Inc., 1975.

Roth, J. Thomas *Continuation of data collection on causes of attrition in initial entry rotary wing training.* Valencia, Penn: Applied Science Associates, Inc., 1980. Contract No. MDA903-79-C-0276.

Siegel, Sidney *Nonparametric statistics for the behavioral sciences.* New York, NY: McGraw-Hill Book Co., 1956.

Uniform guidelines on employee selection procedure. Federal Register, 1978, 43, 166, 38-90.

United States Army Aviation Center, Directorate of Evaluation/Standardization, 1978. *Evaluation of utilization and training preparation for female aviators.* Fort Rucker, Alabama: Department of the Army.

United States Army Aviation Center, 1979. *Human relations and assistance programs for students.* Fort Rucker, Alabama, Department of the Army. USAAVNC Regulation 600-3.

Warrant officer candidate guide. Fort Rucker, Alabama: US Army Aviation Center, November 1977, revised February 1979.

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY OF TERMS

ARMED SERVICES VOCATIONAL APTITUDE BATTERY (ASVAB)

Basic aptitude battery given to Army recruits. A minimum score of 110 on the General Technical (GT) component is required for enlisted flight school applicants. Officers are not required to take the ASVAB.

BASIC COMBAT TRAINING (BCT)

Basic soldier training given to all enlisted Army recruits.

BCT

See Basic Combat Training.

CLASS NUMBER

Each flight class is given a number which denotes the approximate time the class attended flight school, e.g., 79-3, 76-21, 76-501. The first two digits denote the year, the second two or three digits denote the number of the class. Generally, the class numbers are assigned in consecutive order during any one year. Officer classes are assigned even numbers (75-2, 78-8) and warrant officer classes are assigned odd numbers (75-3, 78-9).

FAST

See Flight Aptitude Selection Test

FLIGHT ACADEMIC GRADE

Grade given for classroom exams given during the flight portion of IERW, covering a wide variety of aviation related topics.

FLIGHT APTITUDE SELECTION TEST (FAST)

The FAST is a test designed to measure aptitudes and personality/background characteristics that are predictive of success in Army flight training. The FAST test taken by the students in this study had two batteries - one for officers (OB) and one for WOCs (WOCB). The number and content of the subtests were different as were the minimum required scores. A minimum score of 155 and 300 were required for entry into the flight program for officers and WOCs respectively. This FAST has been superceded by a revised version, Revised FAST, implemented in February 1980.

GT SCORE

General Technical Component of the Armed Services Vocational Aptitude Battery (ASVAB). The GT represents a composite of the arithmetic reasoning and word knowledge subtests.

HUMAN RELATIONS AND ASSISTANCE PROGRAM (HRAP) USAAVNC REGULATION 600-3

Program developed to assist flight school students in transitioning to the Fort Rucker training environment, with primary focus on successful completion of training.

IP CHECKRIDE EVALUATION GRADES

Grades given at the end of each stage (Primary, Transition, Instruments, Night, Tactics) and represents the evaluation of the student's flight skills and knowledges. The student must receive a grade of 70 or better to advance to the next training phase.

IP

Instructor Pilot

INSTRUMENT STAGE

Stage of training in which instrument flight procedures are taught.

IP PUTUP GRADE

An estimate, by the student's IP, of the checkride grade the student will receive. This grade is given for each of the five stages (Primary, Transition, Instruments, Night, and Tactics).

OVERALL GRADE

Composite grade for students completing flight training. Composed of academic and flight grades weighted by factors such as number of hours of instruction.

POI

Program of Instruction

PRIMARY STAGE

Stage of training in which flight dynamics and theory plus TH-55 helicopter flight skills are taught.

SOURCE OF ENTRY

Source from which students enter flight training:
(1) WOC Civilian Entry - less than 6 months military service
(2) WOC previous enlisted - six months or more of military service
(3) ROTC - Reserve Officer training
(4) OCS - Officer candidate school or direct commission or appointment
(5) USMA - US Military Academy

SPSS

Statistical Package for the Social Sciences

STAGE GRADES

Average of the IP putup grade and the checkride evaluation grade. A stage grade is given for each of the following stages: Primary, Transition, Instruments, Night, and Tactics. Reflects student's flight performance only.

STUDENT DISPOSITION CATEGORIES

(1) Academic - failure of written exam
- lack of motivation
- lack of adaptability

(2) Flight - low proficiency
- slow progress
- dangerous tendencies
- fear of flying

(3) Medical

(4) Miscellaneous - lack of prerequisites
- misconduct
- death
- compassionate
- insufficient service
- recall by organization
- erroneous enrollment
- withdrawal in good standing
- honor code violation
- character deficiency
- AWOL
- Resignation
- Other (Military Development deficiency)

TACTICS STAGE

Stage of training in which combat skills (either OH-58 or UH-1) are taught.

TRANSITION STAGE

Stage of training in which the student learns to fly the UH-1H helicopter.

TREDS

TRADOC Educational Data System.

WARRANT OFFICER CANDIDATE

A person who enters the flight program in an enlisted rank. May be student coming directly from BCT, or have had several years enlisted service. Once these individuals complete the flight program, they receive warrant officer appointments.

WARRANT OFFICER MILITARY DEVELOPMENT COURSE (WOCMDC)

A course given to enlisted flight school students designed to assist the WOC in transition from enlisted status to the rank of warrant officer and the designation as an Army aviator.

WOC

See Warrant Officer Candidate.

WOCMDC

See Warrant Officer Military Development Course.

WOCMDC ACADEMIC GRADE

Grade given weekly during WOCMDC to reflect performance and knowledge of classroom type subjects. For instance, map reading, UCMJ, Organization of the Army.

WOCMDC MILITARY DEVELOPMENT GRADES

Weekly grades given to WOC students during the WOCMDC course and during ten weeks of flight training (Preflight and Primary). These grades reflect the students performance on a variety of military topics, e.g., attention to detail, military knowledge, military courtesy, physical fitness, etc. These grades are structured as follows:

O = Outstanding
S+ = Above average
S = Average
S- = Below average
M = Marginal
U = Unsatisfactory

APPENDIX B

METHOD OF DEVELOPING t_c VALUES

The objective of this evaluation is to assess differences among ethnic groups in Army flight training using flight score data as criterion measures. The score data included numeric grades (academic grades) or composite grades which ranged from 70 to 100. A complete description of how these data were gathered and derived is discussed in the text. The approach used for this evaluation was a matched groups design modeled after Baisden and Doll (1978). For reasons of small n and incomplete data, a measure-by-measure matched group power analysis was employed (Cohen, 1977).

The analysis used in the evaluation employed preselected levels of both Type I and Type II error in applying the methods described by Cohen (1977). The conventional .05 level of Type I error was selected. A .2 Type II error level was selected on the basis of the convention suggested by Cohen (1977). The advantage of this procedure is that a probability statement concerning the acceptance of the null hypothesis could be made. This approach should insure that statistical significance is representative of non-trivial differences.

For purposes of creating a general model, Cohen recommends standardization of treatment effects in terms of the standard deviation of mean z scores. In the t-test model, this would be expressed as:

$$d = \frac{M_a - M_b}{\sigma} \qquad (1)$$

Where:

d = effect size for t-tests of means in standard unit

M_a, M_b = population means expressed in raw (original measurement) unit

σ = the standard deviation of either population (since they are assumed equal) (Cohen, 1977, p. 207).

The mathematical relationships among power, alpha, variance, population size, and treatment effects then becomes:

$$z_{1-b} = \frac{d(n-1)\sqrt{2n}}{2(n-1) + 1.21(z_{1-a} - 1.06)} - z_{1-a} \qquad (2)$$

(Cohen, 1980, personal communication)

Where:

z_{1-b} = the percentile of the unit normal curve which gives power

z_{1-a} = the percentile of the unit normal curve for significance

d = the standardized mean difference or effect size

n = the size of each sample

It is apparent from equation 2 that, with all variables held constant, an increase in power results in an increase in effect. Such an increase in power is reflected in the scaled t-value:

$$t = d\sqrt{\frac{n}{2}} \qquad \text{(Cohen, 1977, p. 69)} \qquad (3)$$

Cohen's method of significance testing is to calculate the effect size of a treatment and compare that to a tabled effect size. An alternative is to calculate critical t-values once power and alpha are set. Solving for the standardized mean difference in equation 2 gives:

$$d = \frac{2(n-1) - 1.21(z_{1-a} - 1.06)}{(n-1)\sqrt{2n}} + (z_{1-b} + z_{1-a}) \qquad (4)$$

The relation of the standardized mean difference to the student's t is shown in equation 3. Therefore, equation 4 becomes:

$$t = \frac{2(n-1) - 1.21(z_{1-a} - 1.06)}{2(n-1)} + (z_{1-b} + z_{1-a}) \qquad (5)$$

t-values reported in the text were computed in equation 5.

In the t-model, normality and equivalence of variance are assumed. No gross violations of normality were discovered in the samples. Multiple tests of homogeneity of variance were performed using a .01 level of Type I error as the criterion for significant differences. Only one pair of scores significantly differed from each other, and were excluded from the power analysis.

APPENDIX C

COMPARISON OF MINORITY GROUPS AND MATCHED CONTROLS ON FAST, GT, EDUCATION LEVEL, AND AGE

TABLE C1

COMPARISON OF MINORITY GROUP AND ITS MATCHED CONTROL ON FAST, GT, EDUCATION LEVEL, AND AGE

		OFFICER			WOC		
		BLACK	MC	N	BLACK	MC	N
FAST	$\bar{X}$	228.4	232.0	27	328.9	329.8	30
	t_o	-2.20			-.43		
	t_c	±2.86			±2.85		
GT	$\bar{X}$	Not applicable			123.4	123.5	24
	t_o				-.10		
	t_c				±2.87		
EDLEVEL	$\bar{X}$	15.8	15.9	24	13.5	13.18	27
	t_o	-.57			2.07		
	t_c	±2.87			±2.86		
AGE	$\bar{X}$	25.6	25.5	26	24.6	24.2	28
	t_o	-.21			.75		
	t_c	±2.86			±2.86		

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE C2

COMPARISON OF MINORITY GROUP AND ITS MATCHED CONTROL ON FAST, GT, EDUCATION LEVEL, AND AGE

		OFFICER			WOC		
		HISPANIC	MC	N	HISPANIC	MC	N
FAST	$\bar{X}$	251.1	248.7	15	332.9	334.7	30
	t_o	1.05			-.85		
	t_c	±2.91			±2.85		
GT	$\bar{X}$	Not applicable			120.7	121.4	30
	t_o				-.74		
	t_c				±2.85		
EDLEVEL	$\bar{X}$	16.1	16.1	11	13.17	13.17	30
	t_o	0			0		
	t_c	N/A			N/A		
AGE	$\bar{X}$	27.1	25.5	12	25.5	24.4	30
	t_o	2.16			2.25		
	t_c	±2.94			±2.85		

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE C3

COMPARISON OF MINORITY GROUP AND ITS MATCHED CONTROL ON FAST, GT, EDUCATION LEVEL, AND AGE

		OFFICER			WOC		
		ASIAN	MC	N	ASIAN	MC	N
FAST	$\bar{X}$	258.0	265.7	3	345.6	343.9	14
	t_o	-1.26			.90		
	t_c	>|3.18|			±2.92		
GT	$\bar{X}$	Not applicable			123.8	123.5	15
	t_o				.13		
	t_c				±2.91		
EDLEVEL	$\bar{X}$	16.0	16.0		13.46	13.1	15
	t_o	0			-1.31		
	t_c	N/A			±2.91		
AGE	$\bar{X}$	25.0	24.7	3	25.5	25.3	15
	t_o	-.37			.24		
	t_c	>|3.18|			±2.91		

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE C4

COMPARISON OF MINORITY GROUP AND ITS MATCHED CONTROL ON FAST, GT, EDUCATION LEVEL, AND AGE

		OFFICER			WOC		
		INDIAN	MC	N	INDIAN	MC	N
FAST	$\bar{X}$	299.6	309.3	9	337.2	339.7	20
	t_o	-.34			-.96		
	t_c	±2.99			±2.88		
GT	$\bar{X}$	Not applicable			121.6	119.5	17
	t_o				1.51		
	t_c				±2.89		
EDLEVEL	$\bar{X}$	15.33	15.67	9	12.79	12.53	19
	t_o	-.71			1.23		
	t_c	±2.99			±2.88		
AGE	$\bar{X}$	25.1	25.7	9	24.4	24.3	19
	t_o	-.44			.42		
	t_c	±2.99			±2.88		

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE C5

COMPARISON OF MINORITY GROUP AND ITS MATCHED CONTROL ON FAST, GT, EDUCATION LEVEL, AND AGE

		OFFICER			WOC		
		FEMALE	MC	N	FEMALE	MC	N
FAST	$\bar{X}$	251.5	253.0	15	321.4	321.8	27
	t_o	-1.04			-.38		
	t_c	±2.91			±2.86		
GT	$\bar{X}$	Not applicable			134.7	135.7	22
	t_o				-.87		
	t_c				±2.87		
EDLEVEL	$\bar{X}$	16.3	16.0	10	13.1	13.52	23
	t_o	1.41			-2.01		
	t_c	±2.97			±2.87		
AGE	$\bar{X}$	25.7	25.3	11	22.8	23.5	24
	t_o	.66			-1.25		
	t_c	±2.95			±2.87		

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

APPENDIX D

COMPARISON OF MINORITY GROUPS AND TOTAL MAJORITY (WHITE) STUDENTS ON FAST, GT, EDUCATION LEVEL, AND AGE

TABLE D1

COMPARISON OF BLACK AND TOTAL MAJORITY STUDENTS IN IERW ACROSS FAST, GT, EDUCATION LEVEL, AND AGE
JULY 1974 THROUGH JULY 1979

		OFFICER				WOC			
		BLACK	MAJORITY	t_o	t_c	BLACK	MAJORITY	t_o	t_c
FAST	$\bar{X}$	228.4	288.3			328.9	341.4		
	σ	52.3	59.3	-5.70*	±2.86	28.3	29.9	-2.36	±2.85
	N	27	678			30	2071		
GT	$\bar{X}$	Not applicable				123.4	126.5		
	σ					10.2	11.1	-1.45	±2.87
	N					24	1844		
EDUCATION LEVEL	$\bar{X}$	15.8	16			13.5	13.1		
	σ	.88	.9	-1.08	±2.87	1.48	1.3	1.37	±2.86
	N	24	1348			27	2267		
AGE	$\bar{X}$	25.6	25.4			24.6	24.0		
	σ	2.25	2.3	.44	±2.86	2.9	3.4	1.07	±2.86
	N	26	1361			28	2409		

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE D2

COMPARISON OF HISPANIC AND TOTAL MAJORITY STUDENTS IN IERW ACROSS FAST, GT, EDUCATION LEVEL, AND AGE
JULY 1974 THROUGH JULY 1979

		OFFICER				WOC			
		HISPANIC	MAJORITY	t_o	t_c	HISPANIC	MAJORITY	t_o	t_c
FAST	$\bar{X}$	251.1	288.3			332.9	341.4		
	σ	61.3	59.3	-2.25	±2.91	23.7	29.9	-1.91	±2.85
	N	15	678			30	2071		
GT	$\bar{X}$	Not applicable				120.6	126.5		
	σ					10.0	11.1	-3.15*	±2.85
	N					30	1844		
EDUCATION LEVEL	$\bar{X}$	16.1	16.0			13.2	13.1		
	σ	.7	.9	.45	±2.95	1.3	1.3	.41	±2.85
	N	11	1348			30	2267		
AGE	$\bar{X}$	27.1	25.4			25.5	24.0		
	σ	2.39	2.3	2.35	±2.94	2.8	3.4	2.86*	±2.85
	N	12	1361			30	2409		

t_o = observed t value
t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE D3

COMPARISON OF ASIAN AND TOTAL MAJORITY STUDENTS IN IERW ACROSS FAST, GT, EDUCATION LEVEL, AND AGE
JULY 1974 THROUGH JULY 1979

		OFFICER				WOC			
		ASIAN	MAJORITY	t_o	t_c	ASIAN	MAJORITY	t_o	t_c
FAST	$\bar{X}$	258.0	288.3			345.6	341.4		
	σ	46.9	59.3	-.91	$>\|3.18\|$	32.96	29.9	.46	±2.92
	N	3	678			14	2071		
GT	$\bar{X}$	Not applicable				123.8	126.5		
	σ					10.8	11.1	-.93	±2.91
	N					15	1844		
EDUCATION LEVEL	$\bar{X}$	16.0	16.0			13.46	13.1		
	σ	0	.9	0	N/A	1.4	1.3	.96	±2.91
	N	3	1348			15	2267		
AGE	$\bar{X}$	25.0	25.4			25.5	24.0		
	σ	1.0	2.3	-.97	$>\|3.18\|$	4.9	3.4	1.14	±2.91
	N	3	1361			15	2409		

t_o = observed t value
t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE D4

COMPARISON OF AMERICAN INDIAN AND TOTAL MAJORITIES IN IERW ACROSS FAST, GT, EDUCATION LEVEL, AND AGE
JULY 1974 THROUGH JULY 1979

		OFFICER				WOC			
		INDIAN	MAJORITY	t_o	t_c	INDIAN	MAJORITY	t_o	t_c
FAST	$\bar{X}$	299.6	288.3			337.2	341.4		
	σ	56.6	59.3	.56	±2.99	24.9	29.9	-.73	±2.88
	N	9	678			20	2071		
GT	$\bar{X}$	Not applicable				122.0	126.5		
	σ					7.44	11.1	-2.40	±2.89
	N					17	1844		
EDUCATION LEVEL	$\bar{X}$	15.3	16.0			12.8	13.1		
	σ	1.4	.9	-1.41	±2.99	1.47	1.3	-.86	±2.88
	N	9	1348			19	2267		
AGE	$\bar{X}$	25.1	25.4			24.4	24.0		
	σ	2.6	2.3	-.33	±2.99	4.37	3.4	.39	±2.88
	N	9	1361			19	2409		

t_o = observed t value
t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE D5

COMPARISON OF FEMALE AND TOTAL MAJORITY STUDENTS IN IERW ACROSS FAST, GT, EDUCATION LEVEL, AND AGE
JULY 1974 THROUGH JULY 1979

		OFFICER				WOC			
		FEMALES	MAJORITY	t_o	t_c	FEMALES	MAJORITY	t_o	t_c
FAST	$\bar{X}$	251.5	288.3			321.4	341.4		
	σ	60.8	59.3	-2.24	±2.91	33.3	29.9	-3.05*	±2.86
	N	15	678			27	2071		
GT	$\bar{X}$	Not applicable				134.7	126.5		
	σ					14.6	11.1	2.57	±2.87
	N					22	1844		
EDUCATION LEVEL	$\bar{X}$	16.3	16.0			13.17	13.1		
	σ	.67	.9	1.34	±2.97	1.49	1.3	.22	±2.87
	N	10	1348			23	2267		
AGE	$\bar{X}$	25.7	25.4			22.79	24.0		
	σ	1.6	2.3	.59	±2.95	3.02	3.4	-1.91	±2.87
	N	11	1361			24	2409		

t_o = observed t value
t_c = critical t value for significance with $\alpha = .05$ and $\beta = .2$

APPENDIX E

COMPARISON OF MINORITY AND MATCHED CONTROL GROUPS ON IERW ACADEMIC GRADES BY STAGE OF TRAINING

TABLE E1

Comparison of minority groups with matched control groups on IERW academic grades by stage of training - Jul 74 through Jul 79.

STAGE = PRIMARY

PERFORMANCE MEASURE = AVERAGE ACADEMIC GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	85.27	5.44	43	3.37*	±2.84
MATCHED CONTROL	88.36	4.75			
HISPANIC	86.58	3.75	37	1.81	±2.84
MATCHED CONTROL	88.26	4.89			
ASIAN	88.22	5.16	17	-.95	±2.89
MATCHED CONTROL	86.39	6.53			
AMERICAN INDIAN	87.4	5.06	24	1.47	±2.86
MATCHED CONTROL	89.44	5.0			
FEMALE	86.90	5.23	29	.92	±2.85
MATCHED CONTROL	88.03	4.96			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

* significant t value

TABLE E2

Comparison of minority groups with matched control groups on IERW academic grades by stage of training - Jul 74 through Jul 79.

STAGE = TRANSITION

PERFORMANCE MEASURE = AVERAGE ACADEMIC GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	92.32	5.41	24	-.66	±2.86
MATCHED CONTROL	91.36	5.33			
HISPANIC	91.33	6.72	17	2.32	±2.89
MATCHED CONTROL	94.83	4.15			
ASIAN	92.0	5.60	3	-.22	>|3.18|
MATCHED CONTROL	91.5	4.43			
AMERICAN INDIAN	92.83	4.24	11	.3	±2.94
MATCHED CONTROL	93.33	5.69			
FEMALE	91.21	7.23	13	.71	±2.92
MATCHED CONTROL	92.78	5.91			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE E3

Comparison of minority groups with matched control groups on IERW academic grades by stage of training - Jul 74 through Jul 79.

STAGE = INSTRUMENTS

PERFORMANCE MEASURE = AVERAGE ACADEMIC GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	87.12	6.72	23	1.77	±2.87
MATCHED CONTROL	90.21	5.12			
HISPANIC	89.67	4.68	17	-.73	±2.89
MATCHED CONTROL	88.83	6.03			
ASIAN	95.50	2.52	3	-1.27	>|3.18|
MATCHED CONTROL	93.75	2.22			
AMERICAN INDIAN	87.73	6.40	10	1.70	±2.95
MATCHED CONTROL	92.10	5.20			
FEMALE	90.36	5.97	13	-.1	±2.92
MATCHED CONTROL	90.14	6.37			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE E4

Comparison of minority groups with matched control groups on IERW academic grades by stage of training - Jun 77 through Jul 79.

STAGE = NIGHT

PERFORMANCE MEASURE = AVERAGE ACADEMIC GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	92.1	6.17	9	0	±2.97
MATCHED CONTROL	92.1	8.27			
HISPANIC	88.64	8.88	13	.93	±2.92
MATCHED CONTROL	91.36	6.39			
ASIAN	90.67	3.56	5	.75	±3.10
MATCHED CONTROL	92.17	4.02			
AMERICAN INDIAN	89.9	3.98	9	1.81	±2.97
MATCHED CONTROL	93.9	4.31			
FEMALE	95.27	4.52	10	-1.96	±2.95
MATCHED CONTROL	91.64	5.66			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE E5

Comparison of minority groups with matched control groups on IERW academic grades by stage of training - Jul 74 through Jul 79.

STAGE = TACTICS

PERFORMANCE MEASURE = AVERAGE ACADEMIC GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	86.22	6.63	22	1.44	±2.87
MATCHED CONTROL	88.61	6.53			
HISPANIC	85.84	7.40	18	1.83	±2.88
MATCHED CONTROL	89.47	6.87			
ASIAN	88.5	5.97	3	-.37	>|3.18|
MATCHED CONTROL	87.5	5.80			
AMERICAN INDIAN	84.58	6.80	11	1.22	±2.94
MATCHED CONTROL	87.92	4.79			
FEMALE	84.50	6.04	11	.82	±2.94
MATCHED CONTROL	87.0	7.51			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

APPENDIX F

COMPARISON OF MINORITY GROUPS WITH MATCHED CONTROL GROUPS ON IERW FLIGHT GRADES BY STAGE OF TRAINING

TABLE F1

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = PRIMARY

PERFORMANCE MEASURE = IP PUTUP GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	83.68	2.67	27	.30	±2.86
MATCHED CONTROL	83.89	4.07			
HISPANIC	83.46	3.23	25	1.51	±2.86
MATCHED CONTROL	84.92	3.44			
ASIAN	84.37	2.50	7	2.26	±3.02
MATCHED CONTROL	86.37	2.07			
AMERICAN INDIAN	84.74	2.84	18	1.52	±2.88
MATCHED CONTROL	85.79	1.72			
FEMALE	85.33	2.09	26	-1.88	±2.86
MATCHED CONTROL	84.44	2.14			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F2

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = PRIMARY

PERFORMANCE MEASURE = CHECKRIDE EVALUATION GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	81.48	4.79	28	2.23	±2.85
MATCHED CONTROL	83.72	2.97			
HISPANIC	80.96	5.49	25	2.18	±2.86
MATCHED CONTROL	84.0	4.82			
ASIAN	83.0	4.57	7	-.04	±3.02
MATCHED CONTROL	82.87	6.10			
AMERICAN INDIAN	81.47	5.76	18	1.04	±2.88
MATCHED CONTROL	83.10	3.84			
FEMALE	83.11	3.35	26	-.69	±2.86
MATCHED CONTROL	82.22	5.17			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .20$

TABLE F3

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = PRIMARY

PERFORMANCE MEASURE = STAGE GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	82.79	3.37	38	1.68	±2.84
MATCHED CONTROL	83.97	3.24			
HISPANIC	83.22	3.68	36	2.09	±2.84
MATCHED CONTROL	84.95	3.34			
ASIAN	83.82	3.43	10	.06	±2.95
MATCHED CONTROL	83.91	4.50			
AMERICAN INDIAN	84.0	3.55	25	1.10	±2.86
MATCHED CONTROL	84.88	2.50			
FEMALE	84.67	2.20	32	-1.88	±2.85
MATCHED CONTROL	83.27	3.56			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F4

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = TRANSITION

PERFORMANCE MEASURE = IP PUTUP GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	84.73	3.07	21	-1.23	±2.88
MATCHED CONTROL	83.59	4.92			
HISPANIC	85.24	4.19	24	.70	±2.86
MATCHED CONTROL	86.04	3.51			
ASIAN	86.67	2.0	8	-.63	±2.99
MATCHED CONTROL	86.0	3.20			
AMERICAN INDIAN	85.84	4.07	18	.27	±2.88
MATCHED CONTROL	86.16	3.88			
FEMALE	84.33	5.28	23	1.67	±2.87
MATCHED CONTROL	86.21	2.98			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .20$

TABLE F5

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = TRANSITION

PERFORMANCE MEASURE = CHECKRIDE EVALUATION GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	82.41	6.97	21	.25	±2.87
MATCHED CONTROL	82.86	6.08			
HISPANIC	84.6	5.27	24	-.09	±2.86
MATCHED CONTROL	84.48	4.72			
ASIAN	84.33	3.24	8	1.36	±2.99
MATCHED CONTROL	86.11	1.90			
AMERICAN INDIAN	84.84	5.26	18	.04	±2.88
MATCHED CONTROL	84.89	6.13			
FEMALE	83.37	5.91	23	.27	±2.87
MATCHED CONTROL	83.71	6.10			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F6

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = TRANSITION

PERFORMANCE MEASURE = STAGE GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	83.88	3.97	33	.33	±2.85
MATCHED CONTROL	84.18	4.83			
HISPANIC	85.31	4.15	35	.95	±2.84
MATCHED CONTROL	86.11	3.25			
ASIAN	86.08	2.11	11	0	±2.94
MATCHED CONTROL	86.08	2.02			
AMERICAN INDIAN	85.85	3.25	25	-.04	±2.86
MATCHED CONTROL	85.81	4.55			
FEMALE	84.23	4.72	29	.90	±2.85
MATCHED CONTROL	85.0	3.72			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F7

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = INSTRUMENTS

PERFORMANCE MEASURE = IP PUTUP GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	82.46	5.09	25	1.23	±2.86
MATCHED CONTROL	83.81	4.05			
HISPANIC	81.88	4.67	24	1.55	±2.86
MATCHED CONTROL	84.00	4.06			
ASIAN	85.11	2.76	8	1.58	±2.99
MATCHED CONTROL	86.78	1.48			
AMERICAN INDIAN	84.16	5.02	18	1.11	±2.88
MATCHED CONTROL	85.47	3.88			
FEMALE	84.35	4.85	22	-.19	±2.87
MATCHED CONTROL	84.13	3.73			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F8

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = INSTRUMENTS

PERFORMANCE MEASURE = CHECKRIDE EVALUATION GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	82.08	5.28	24	-.30	±2.86
MATCHED CONTROL	81.64	5.59			
HISPANIC	83.04	5.84	24	-1.30	±2.86
MATCHED CONTROL	80.88	5.44			
ASIAN	82.33	4.12	8	1.67	±2.99
MATCHED CONTROL	85.33	3.46			
AMERICAN INDIAN	79.74	6.03	18	1.50	±2.88
MATCHED CONTROL	82.58	6.68			
FEMALE	83.61	6.43	22	-1.03	±2.87
MATCHED CONTROL	81.74	5.96			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F9

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = INSTRUMENTS

PERFORMANCE MEASURE = STAGE GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	81.61	4.98	38	1.10	±2.84
MATCHED CONTROL	82.67	3.92			
HISPANIC	83.42	4.11	35	.03	±2.84
MATCHED CONTROL	83.44	4.11			
ASIAN	84.0	2.70	11	.42	±2.94
MATCHED CONTROL	84.58	5.02			
AMERICAN INDIAN	82.0	4.39	25	1.67	±2.86
MATCHED CONTROL	84.04	4.96			
FEMALE	84.72	4.77	28	-1.83	±2.85
MATCHED CONTROL	82.62	4.35			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F10

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jun 77 through Jul 79.

STAGE = NIGHT

PERFORMANCE MEASURE = IP PUTUP GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	85.80	2.77	4	-.47	±3.18
MATCHED CONTROL	85.20	3.35			
HISPANIC	86.20	3.15	9	.55	±2.97
MATCHED CONTROL	87.10	3.96			
ASIAN	85.75	1.71	3	1.85	>|3.18|
MATCHED CONTROL	87.75	2.22			
AMERICAN INDIAN	86.71	4.54	6	-.44	±3.10
MATCHED CONTROL	85.86	2.03			
FEMALE	86.33	2.83	8	1.01	±2.99
MATCHED CONTROL	87.55	1.51			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F11

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jun 77 through Jul 79.

STAGE = NIGHT

PERFORMANCE MEASURE = CHECKRIDE EVALUATION GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	82.20	7.26	4	1.45	±3.18
MATCHED CONTROL	86.40	1.67			
HISPANIC	86.80	1.93	9	.41	±2.97
MATCHED CONTROL	87.30	3.89			
ASIAN	86.75	1.71	3	.61	>|3.18|
MATCHED CONTROL	88.0	3.16			
AMERICAN INDIAN	86.0	3.05	6	.68	±3.05
MATCHED CONTROL	86.57	2.30			
FEMALE	86.11	2.80	8	2.09	±2.99
MATCHED CONTROL	88.33	1.80			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F12

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jun 77 through Jul 79.

STAGE = NIGHT

PERFORMANCE MEASURE = STAGE GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	84.50	3.82	17	.92	±2.89
MATCHED CONTROL	85.50	3.13			
HISPANIC	86.85	2.13	19	.44	±2.88
MATCHED CONTROL	87.25	3.37			
ASIAN	85.57	1.90	6	1.75	±3.05
MATCHED CONTROL	87.14	2.61			
AMERICAN INDIAN	86.54	3.45	12	.30	±2.93
MATCHED CONTROL	86.85	2.11			
FEMALE	86.15	3.21	12	.74	±2.93
MATCHED CONTROL	86.92	2.50			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F13

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = TACTICS

PERFORMANCE MEASURE = IP PUTUP SCORE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	86.60	3.05	4	1.73	±3.18
MATCHED CONTROL	89.20	1.09			
HISPANIC	86.33	2.96	8	.49	±2.99
MATCHED CONTROL	85.78	3.31			
ASIAN	87.0	1.41	3	.30	>|3.18|
MATCHED CONTROL	87.5	3.0			
AMERICAN INDIAN	89.33	1.97	5	-.57	±3.10
MATCHED CONTROL	88.33	3.93			
FEMALE	88.71	3.04	6	.23	±3.05
MATCHED CONTROL	89.14	3.80			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F14

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = TACTICS

PERFORMANCE MEASURE = CHECKRIDE EVALUATION GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	86.2	5.54	4	.14	±3.18
MATCHED CONTROL	86.6	3.36			
HISPANIC	82.0	6.18	8	-.03	±2.99
MATCHED CONTROL	81.89	8.70			
ASIAN	86.50	1.91	3	2.42	>|3.18|
MATCHED CONTROL	90.25	2.22			
AMERICAN INDIAN	88.0	3.22	5	.55	±3.10
MATCHED CONTROL	89.0	2.76			
FEMALE	87.28	3.86	6	-1.13	±3.05
MATCHED CONTROL	84.28	4.99			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

TABLE F15

Comparison of minority groups with matched control groups on IERW flight grades by stage of training - Jul 74 through Jul 79.

STAGE = TACTICS

PERFORMANCE MEASURE = STAGE GRADE

GROUP	MEAN	S.D.	df	t_o	t_c
BLACK	86.78	3.04	17	.19	±2.89
MATCHED CONTROL	87.06	4.56			
HISPANIC	84.39	4.37	17	1.65	±2.89
MATCHED CONTROL	86.50	4.55			
ASIAN	86.0	2.71	6	.09	±3.05
MATCHED CONTROL	86.14	6.49			
AMERICAN INDIAN	88.27	2.45	10	.65	±2.95
MATCHED CONTROL	89.0	2.28			
FEMALE	86.0	5.86	10	.54	±2.95
MATCHED CONTROL	86.91	3.96			

t_o = observed t value

t_c = critical t value required for significance with $\alpha = .05$ and $\beta = .2$

APPENDIX G

ILLUSTRATION OF WOCMDC ATTRITION EXPERIENCE BY MINORITY AND MATCHED CONTROL GROUP

WOCMDC ATTRITION FLOW DIAGRAM

MINORITY = BLACK

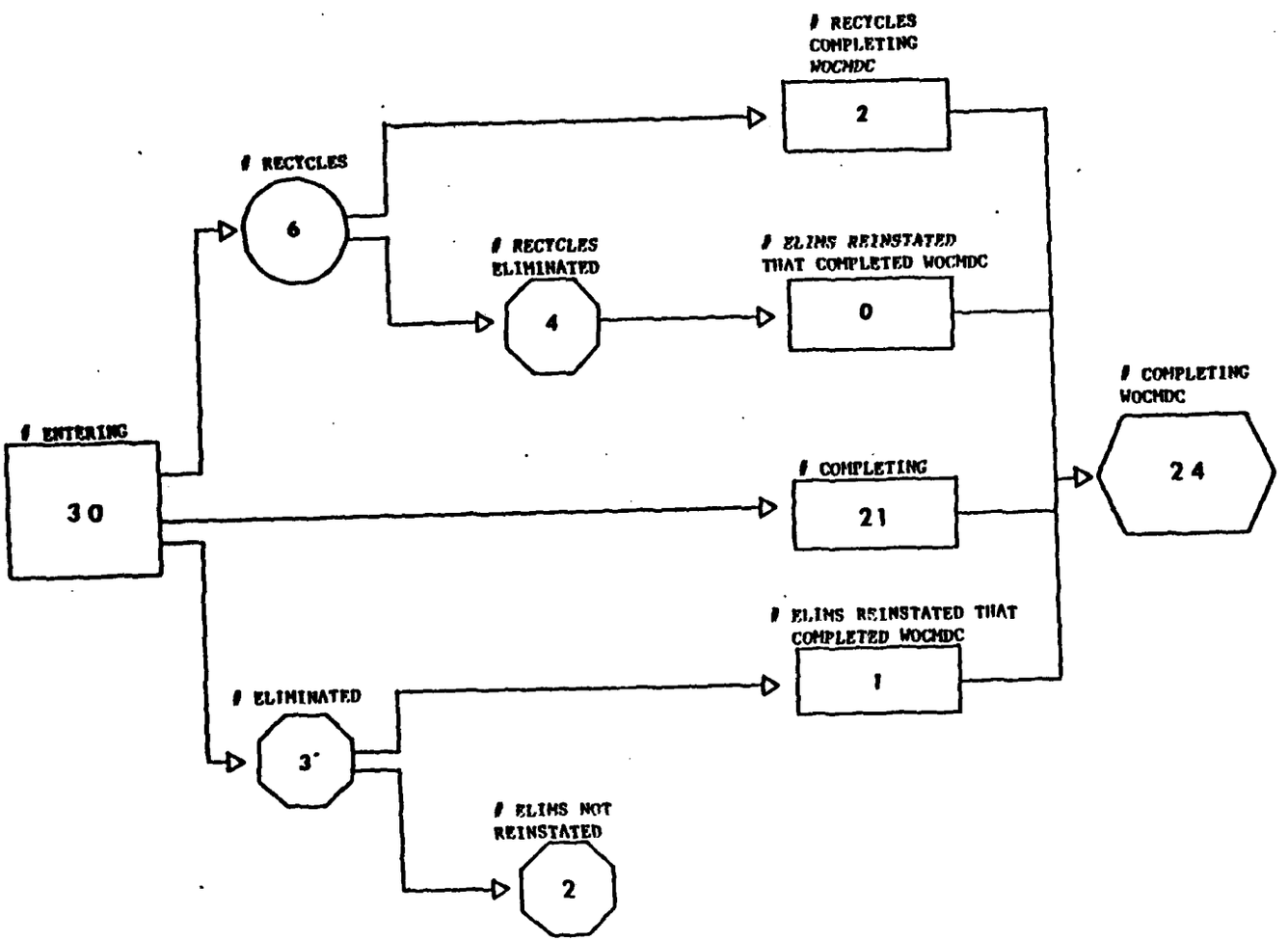


FIGURE G1

WOCMDC ATTRITION FLOW DIAGRAM

MATCHED CONTROL FOR BLACK

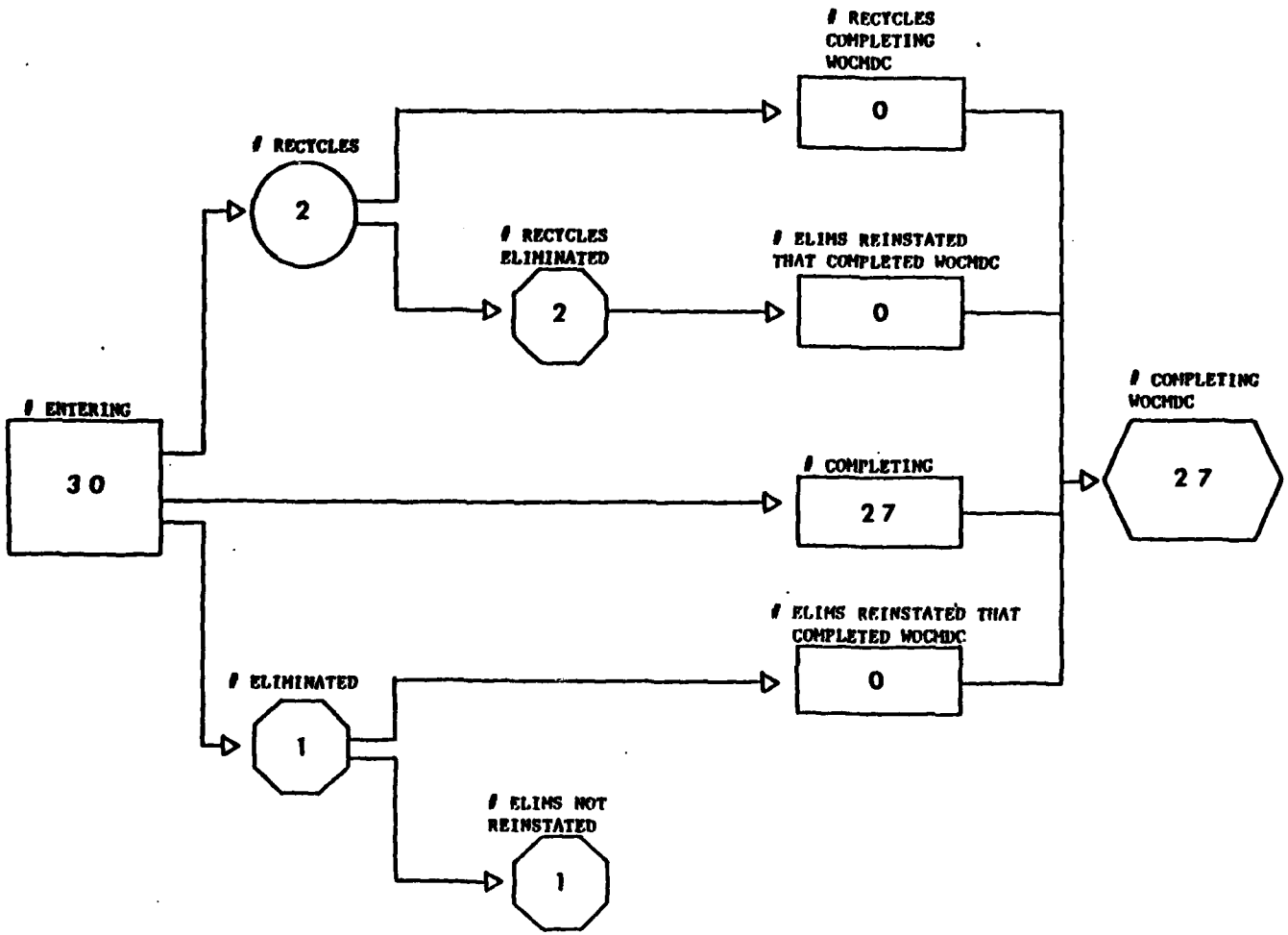


FIGURE G2

WOCMDC ATTRITION FLOW DIAGRAM

MINORITY = HISPANIC

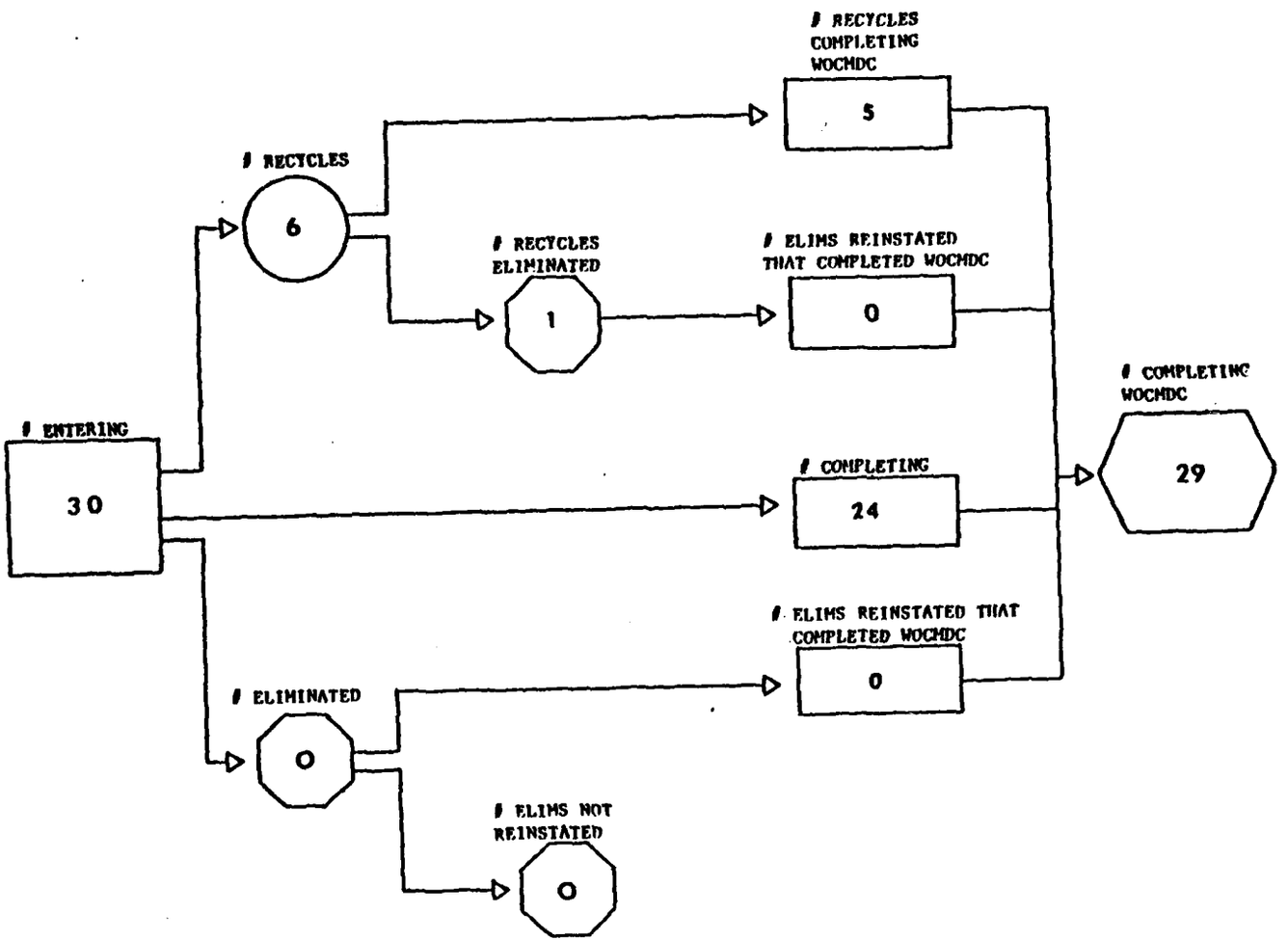


FIGURE G3

WOCMDC ATTRITION FLOW DIAGRAM

MATCHED CONTROL FOR HISPANIC

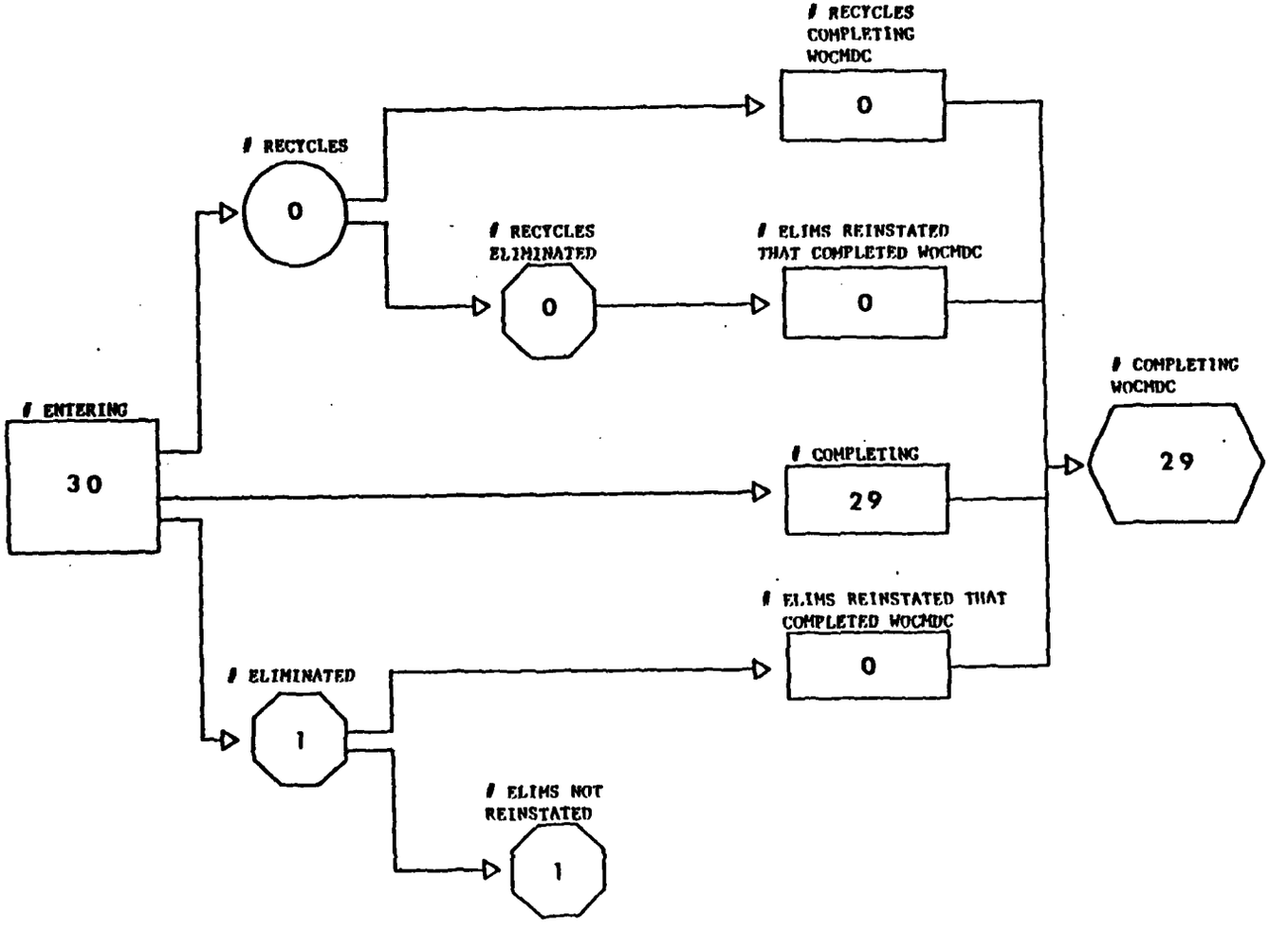


FIGURE G4

WOCMDC ATTRITION FLOW DIAGRAM

MINORITY = ASIAN

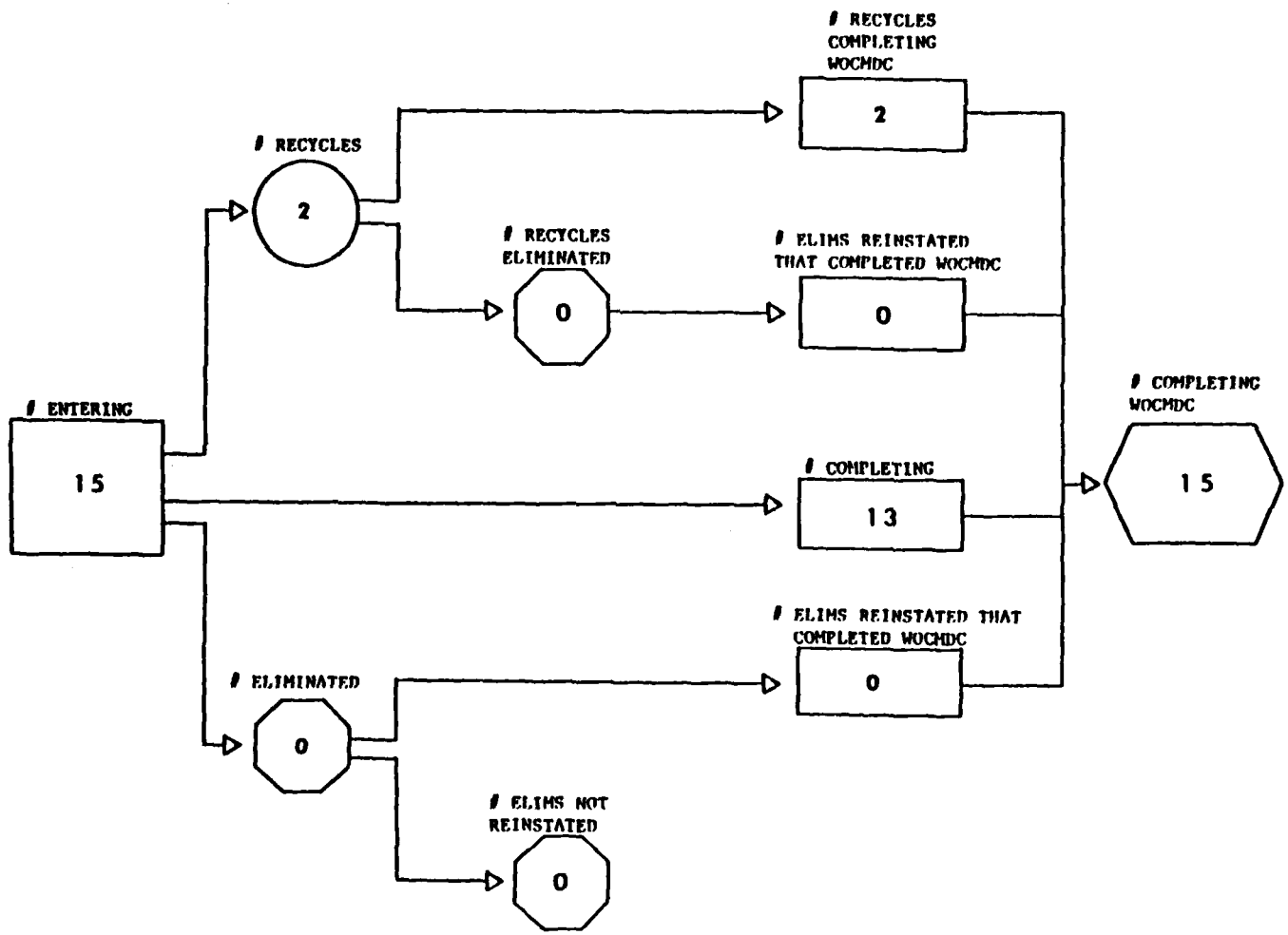


FIGURE G5

WOCMDC ATTRITION FLOW DIAGRAM

MATCHED CONTROL FOR ASIAN

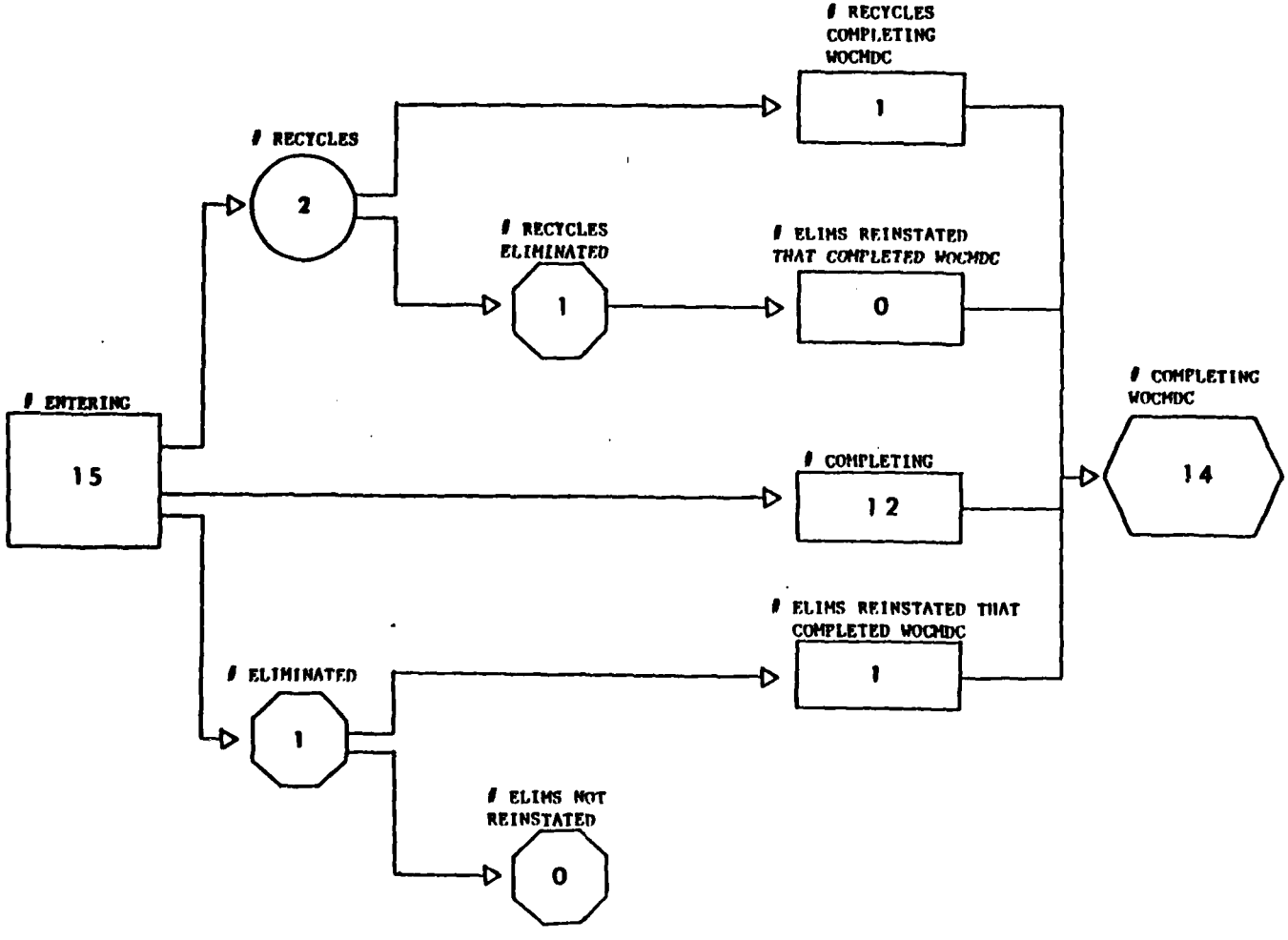


FIGURE G6

WOCMDC ATTRITION FLOW DIAGRAM

MINORITY = INDIAN

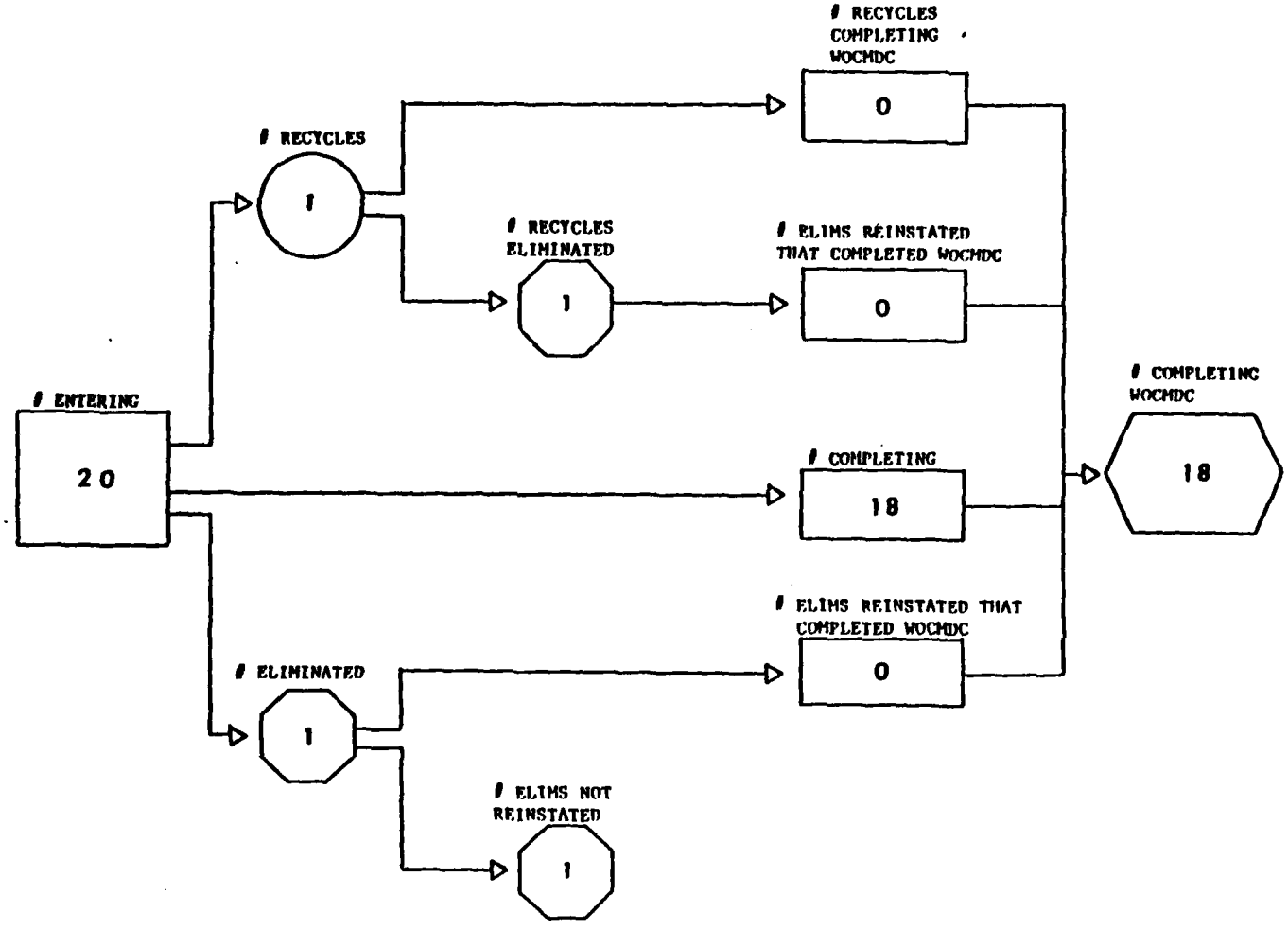


FIGURE G7

WOCMDC ATTRITION FLOW DIAGRAM

MATCHED CONTROL FOR INDIAN

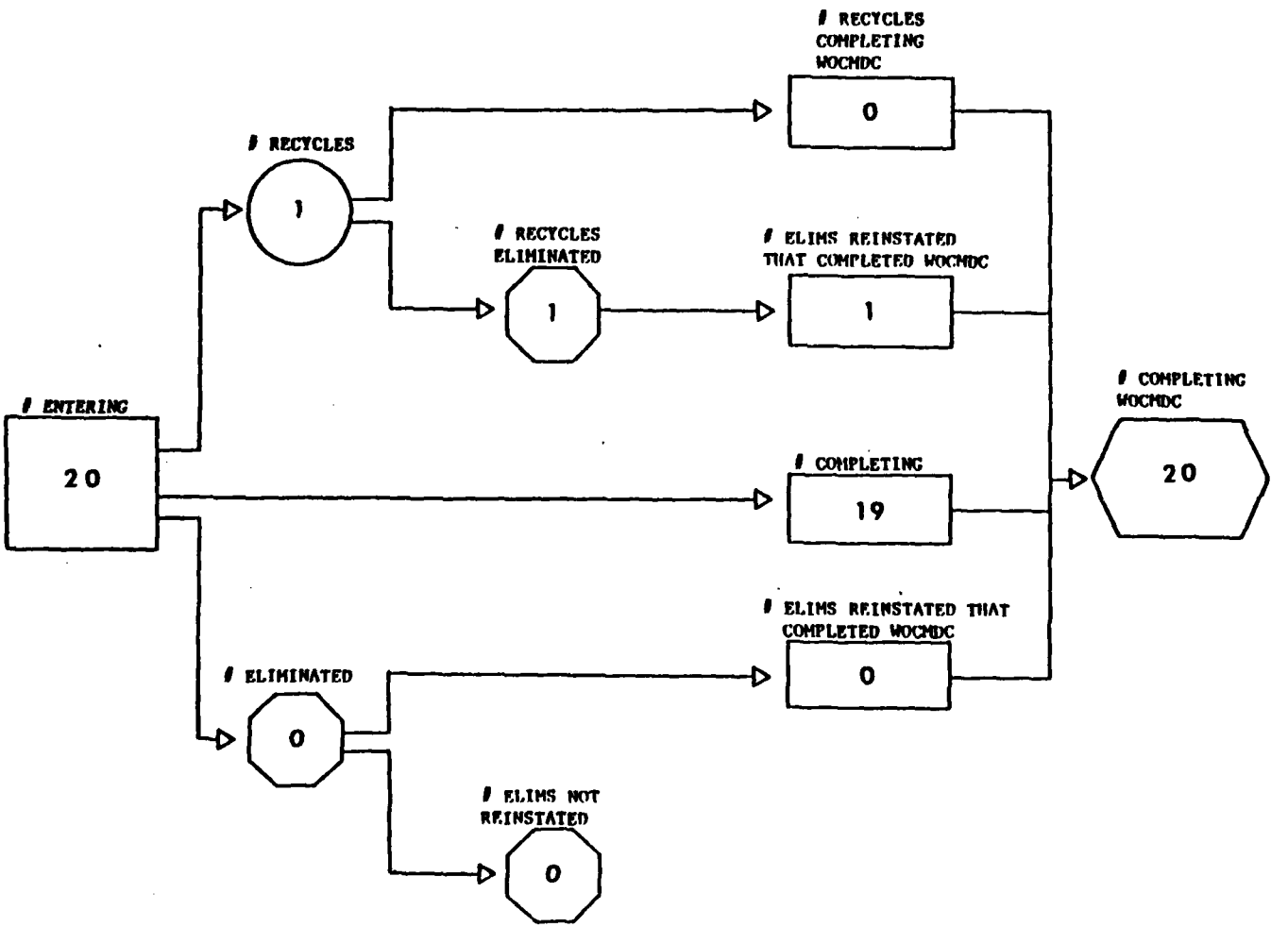


FIGURE G8

WOCMDC ATTRITION FLOW DIAGRAM

MINORITY - FEMALES

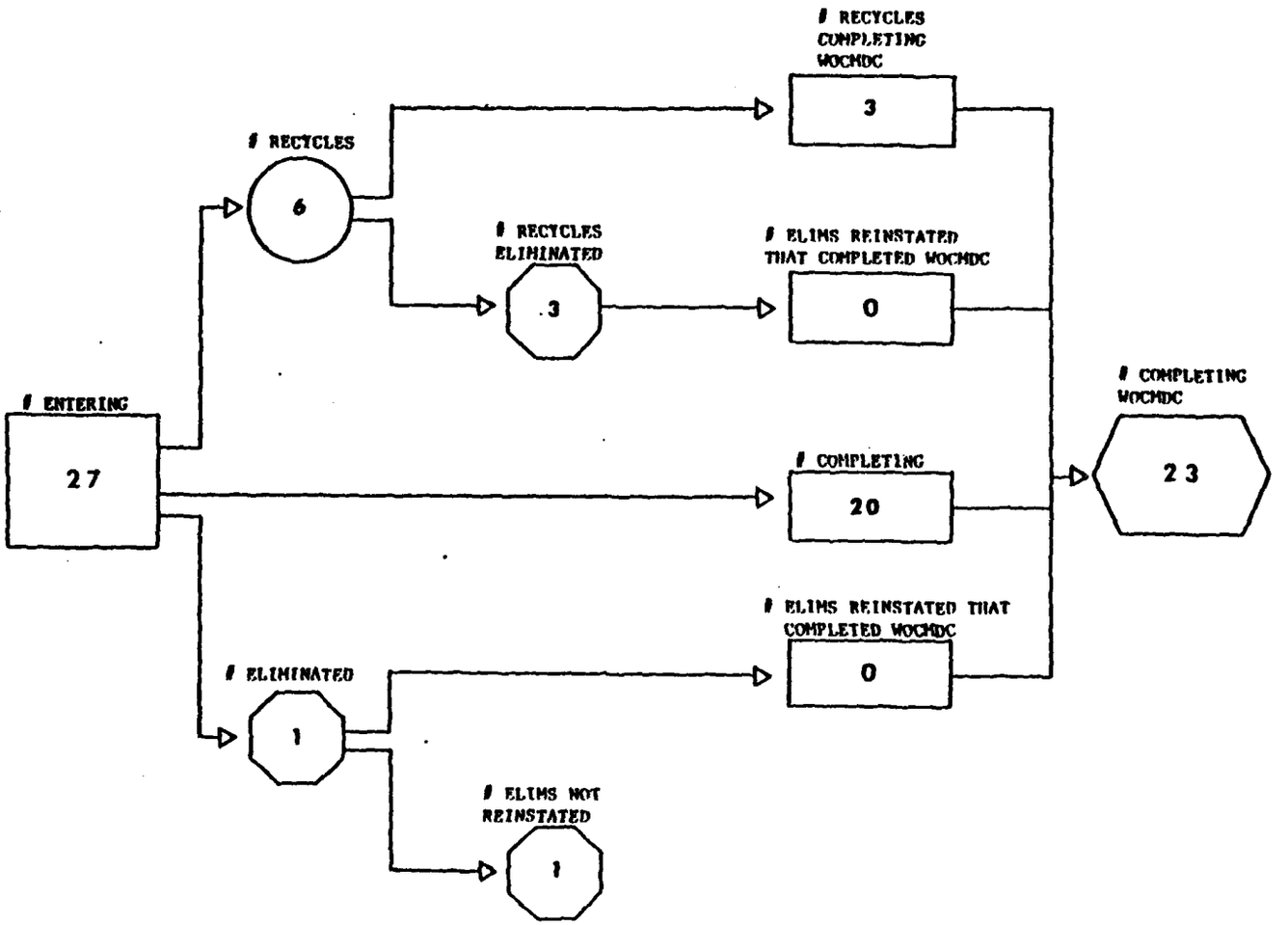


FIGURE G9

WOCMDC ATTRITION FLOW DIAGRAM

MATCHED CONTROL FOR FEMALES

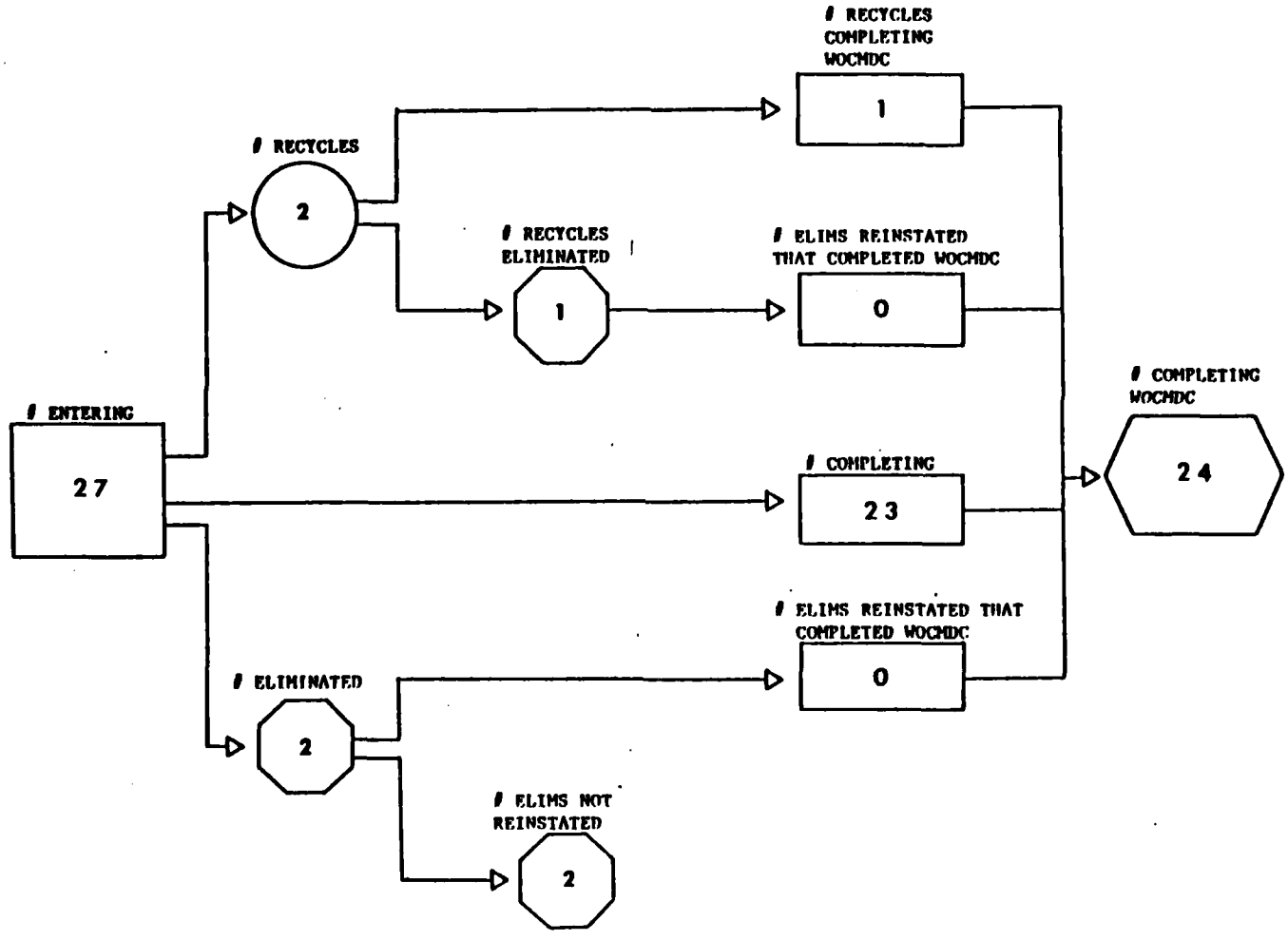


FIGURE G10

APPENDIX H

ILLUSTRATION OF FLIGHT TRAINING ATTRITION EXPERIENCE BY MINORITY AND MATCHED CONTROL GROUPS

FLIGHT TRAINING ATTRITION EXPERIENCE

MINORITY = BLACK

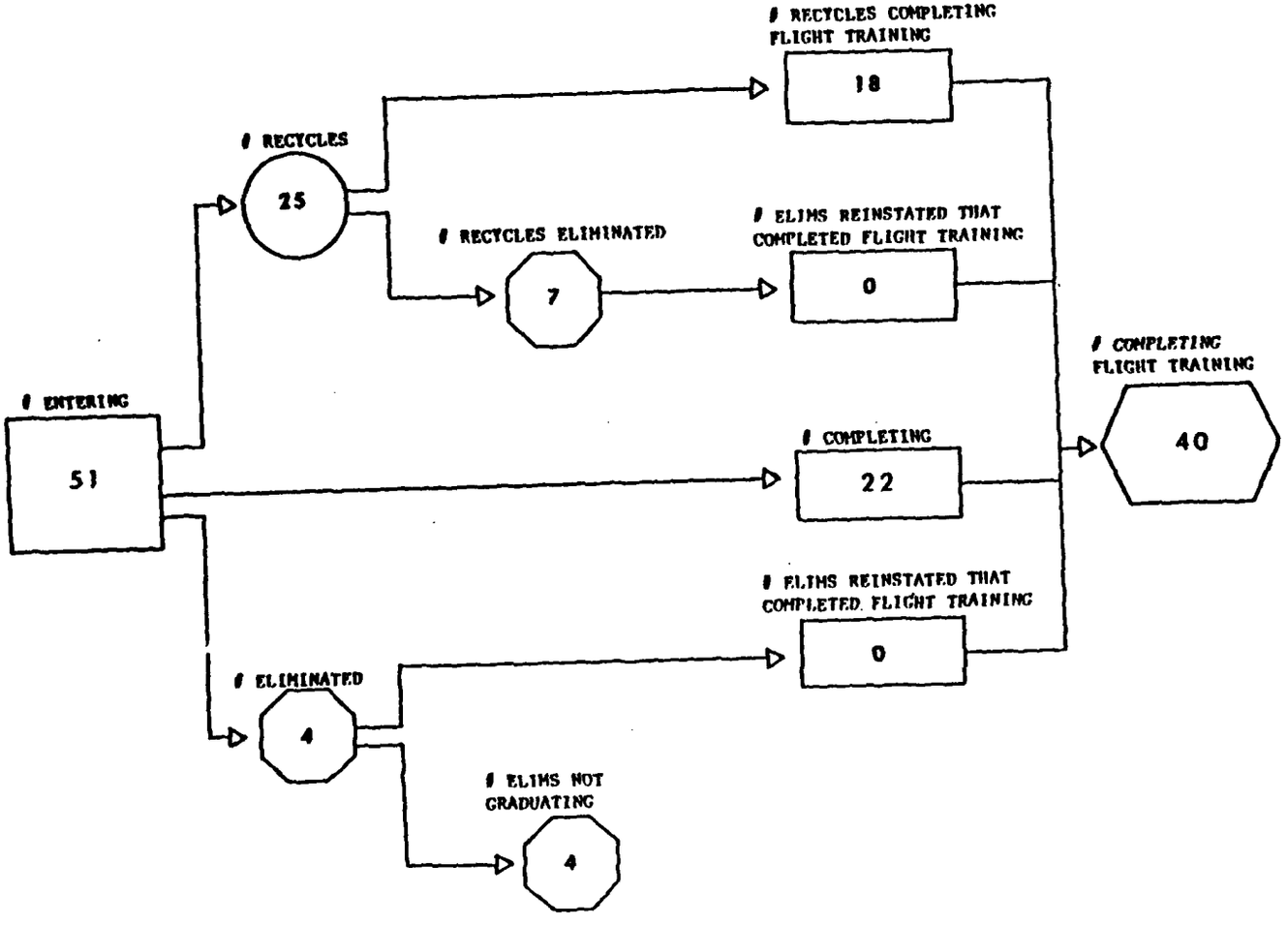


FIGURE H1

FLIGHT TRAINING ATTRITION EXPERIENCE

MATCHED CONTROL FOR BLACKS

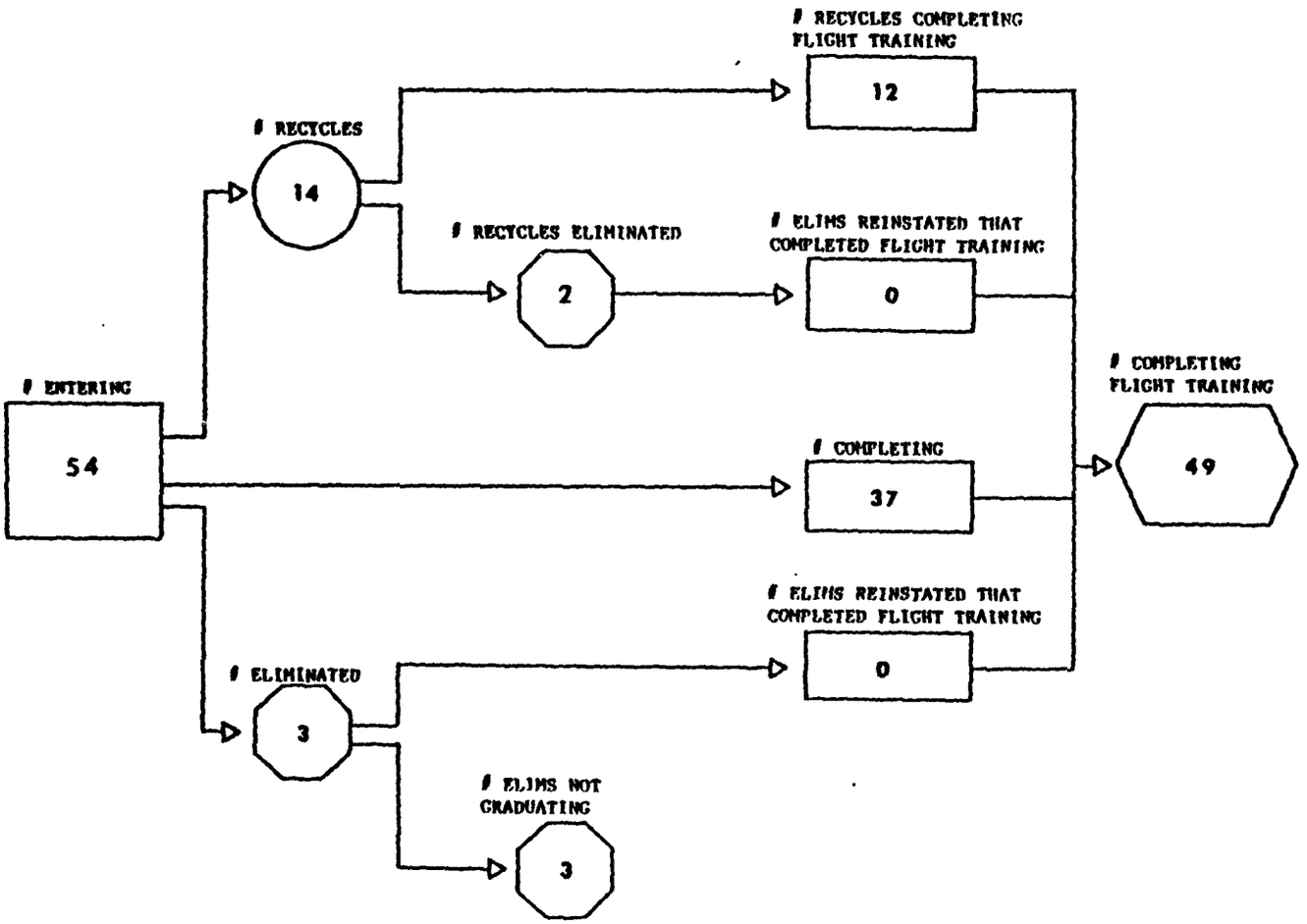


FIGURE H2

FLIGHT TRAINING ATTRITION EXPERIENCE

MINORITY = HISPANIC

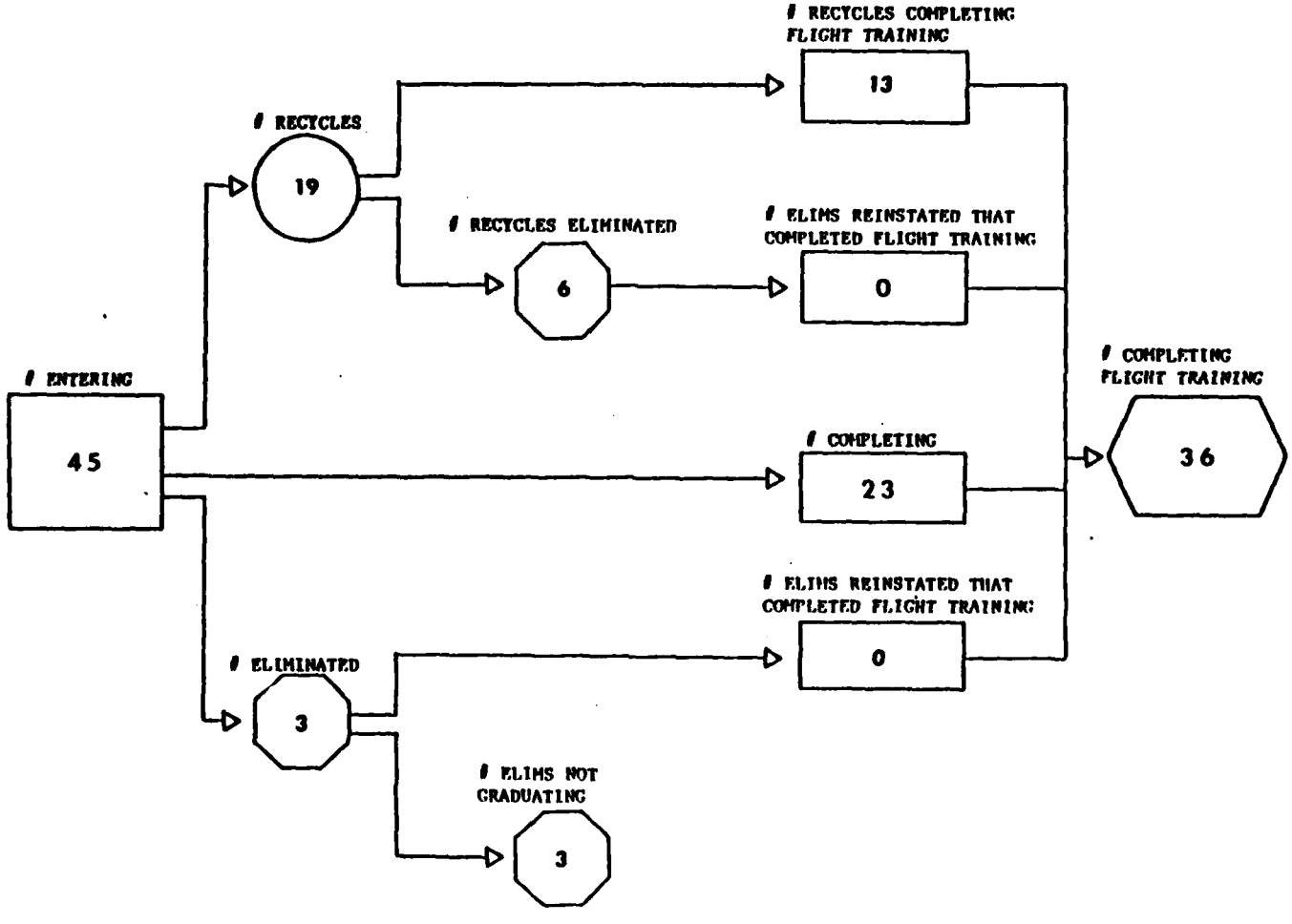


FIGURE H3

FLIGHT TRAINING ATTRITION EXPERIENCE

MATCHED CONTROL FOR HISPANIC

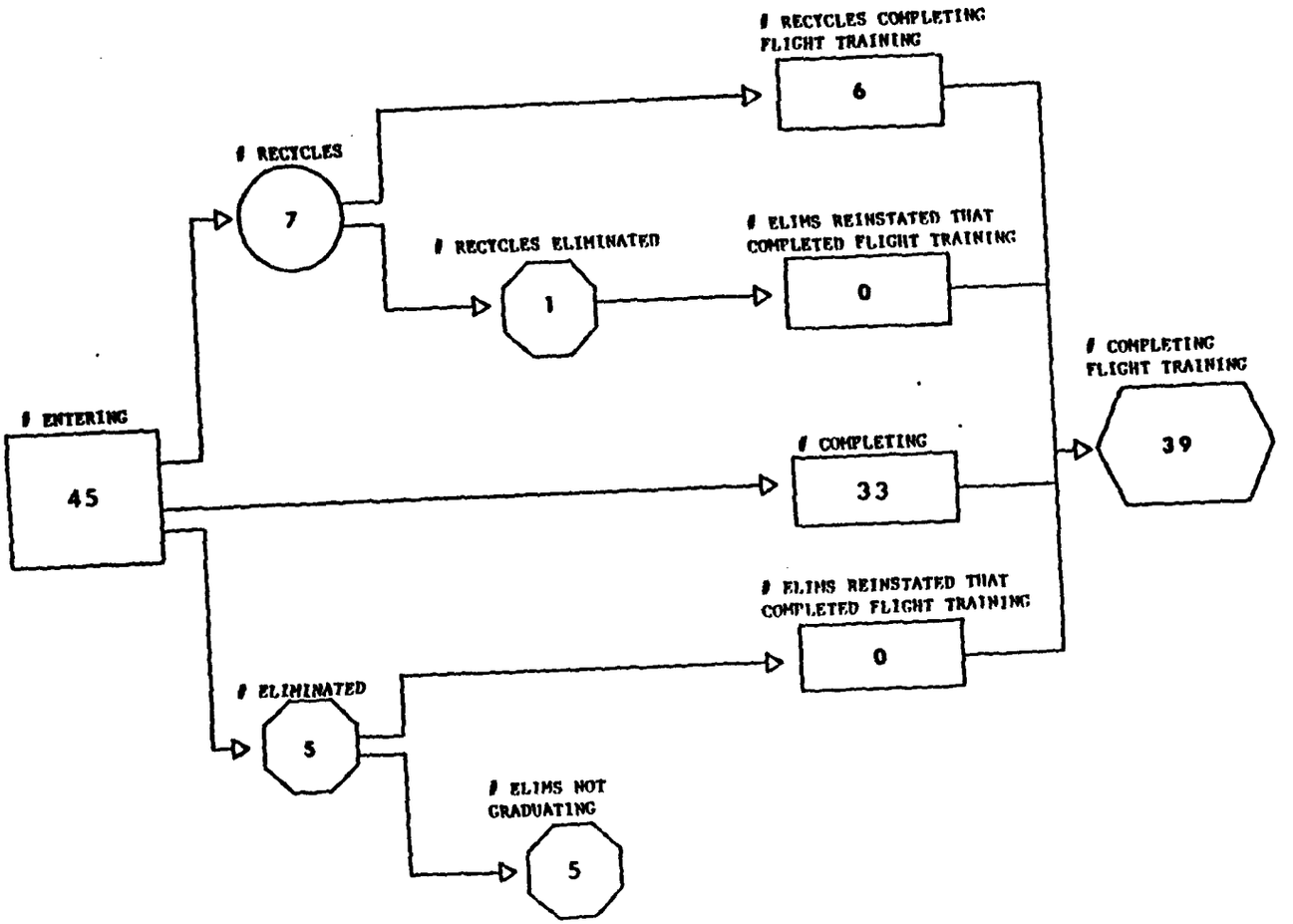


FIGURE H4

FLIGHT TRAINING ATTRITION EXPERIENCE

MINORITY = ASIAN

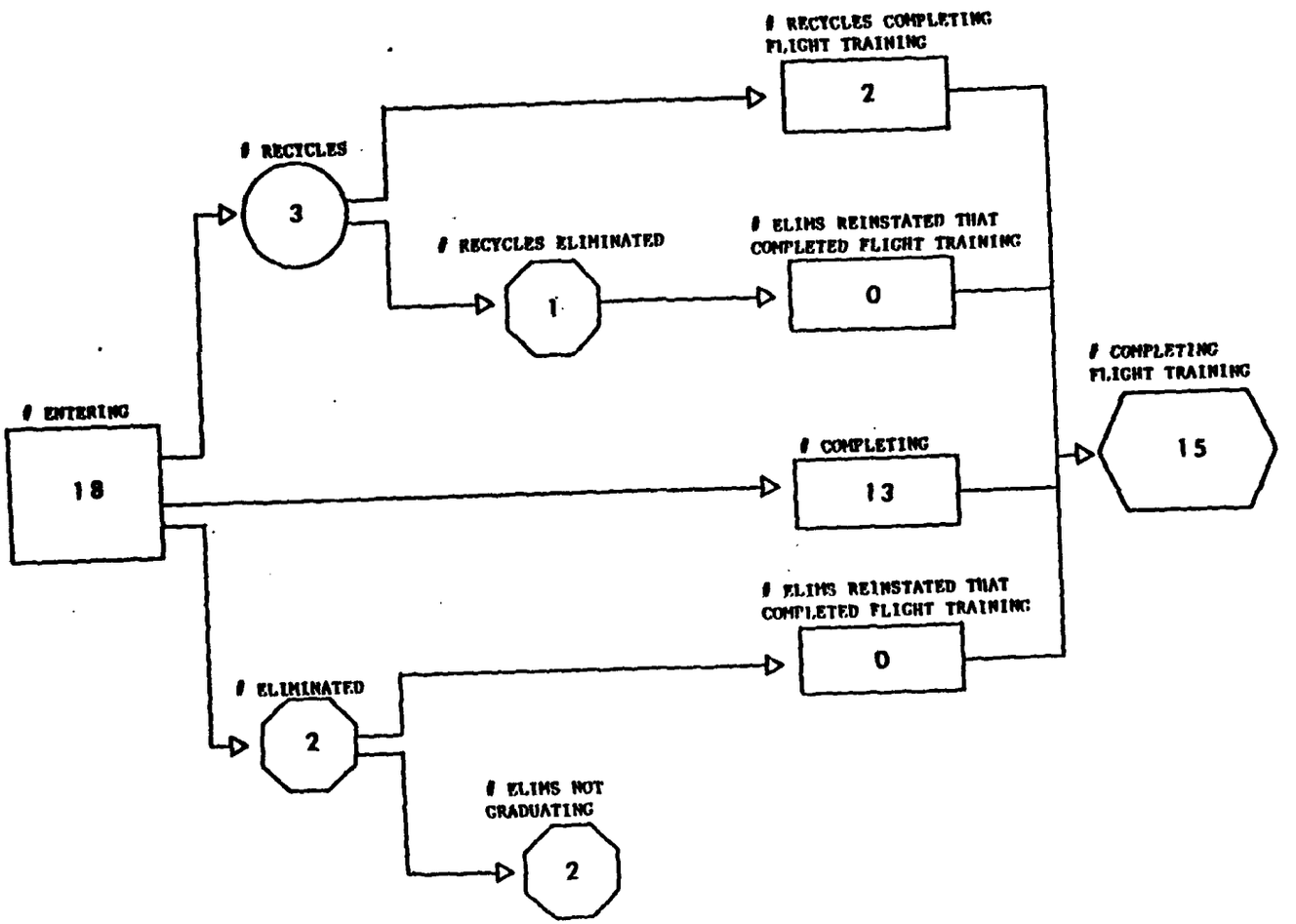


FIGURE H5

FLIGHT TRAINING ATTRITION EXPERIENCE

MATCHED CONTROLS FOR ASIAN

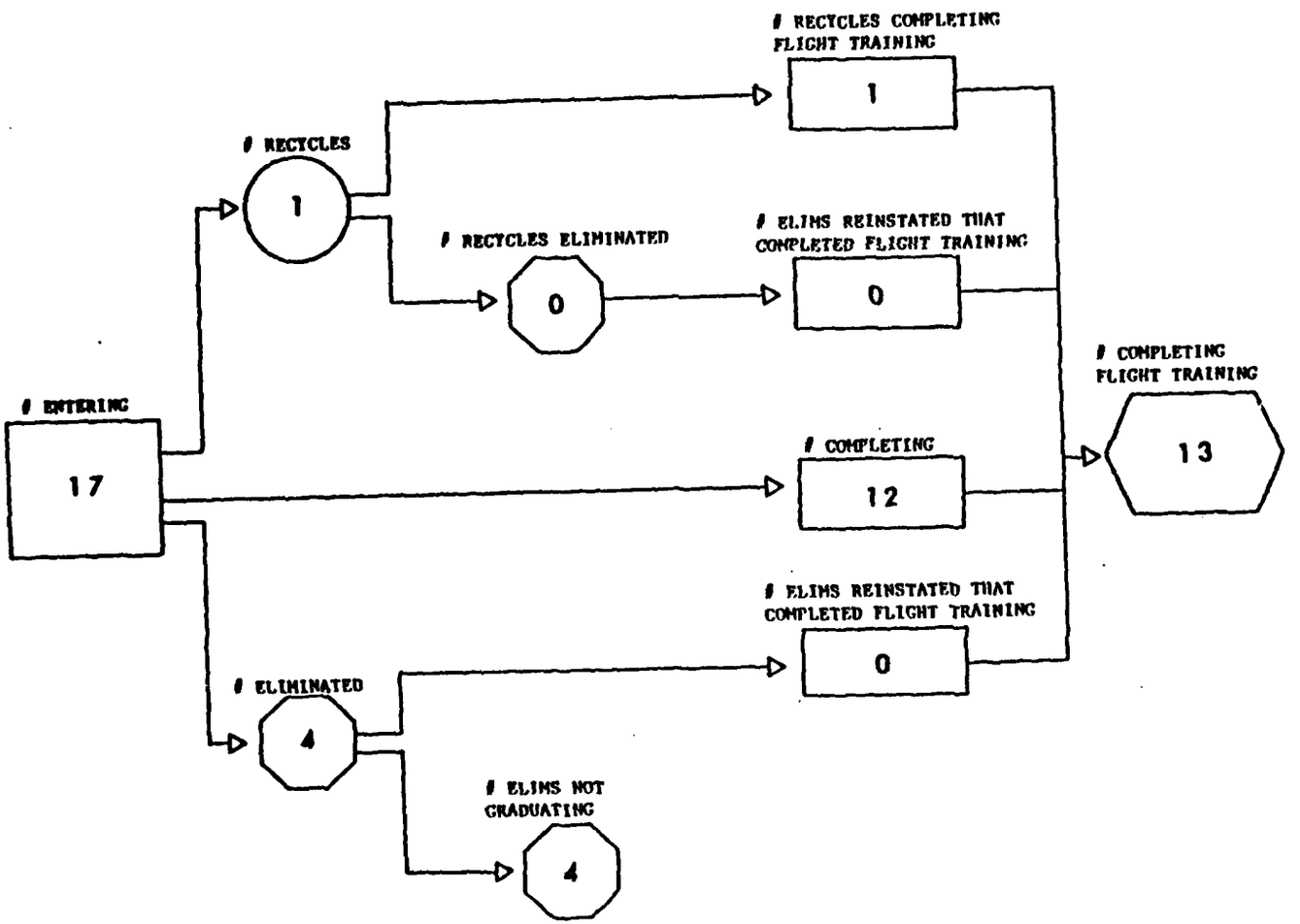


FIGURE H6

FLIGHT TRAINING ATTRITION EXPERIENCE

MINORITY = INDIAN

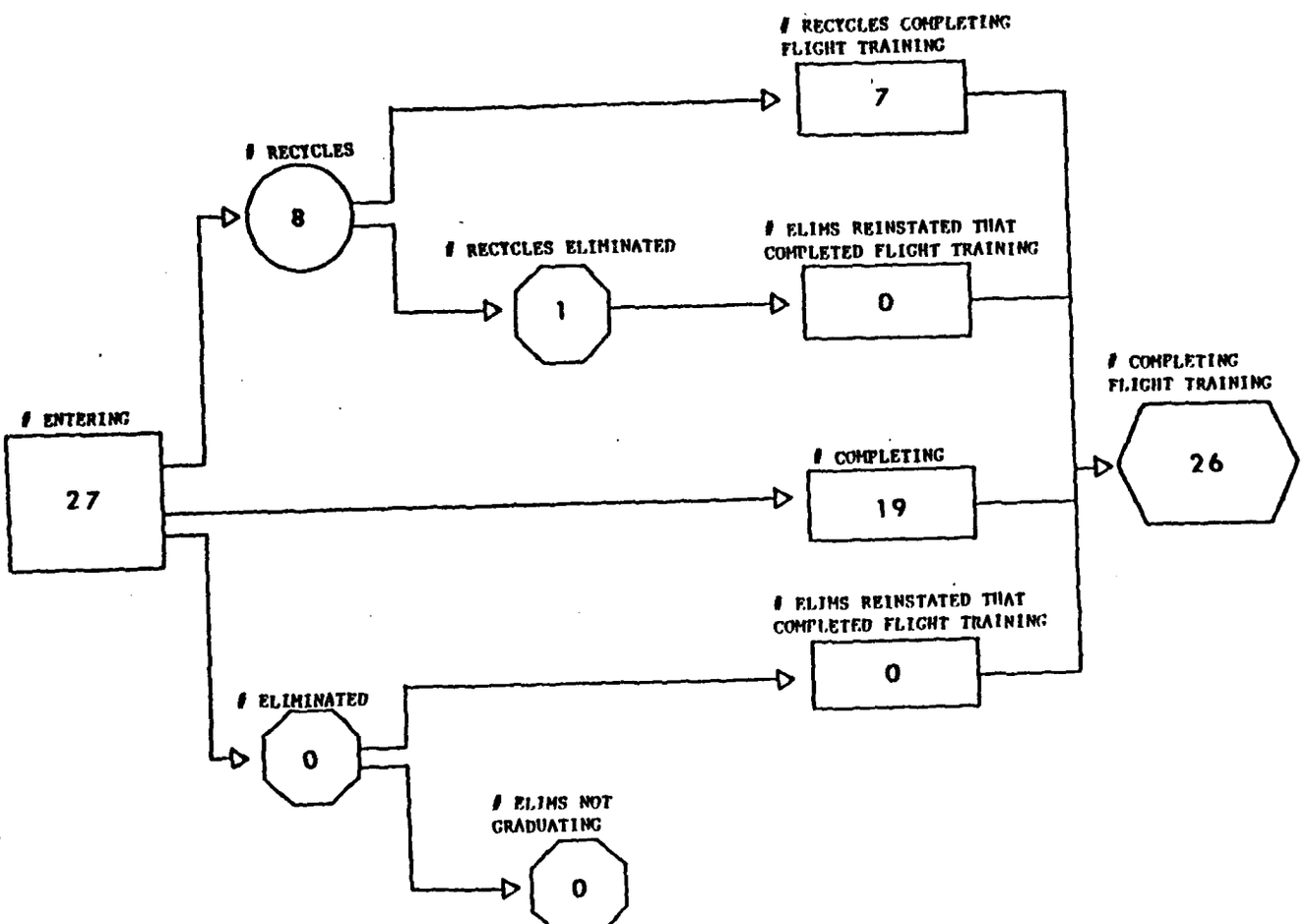


FIGURE H7

FLIGHT TRAINING ATTRITION EXPERIENCE

MATCHED CONTROLS FOR INDIANS

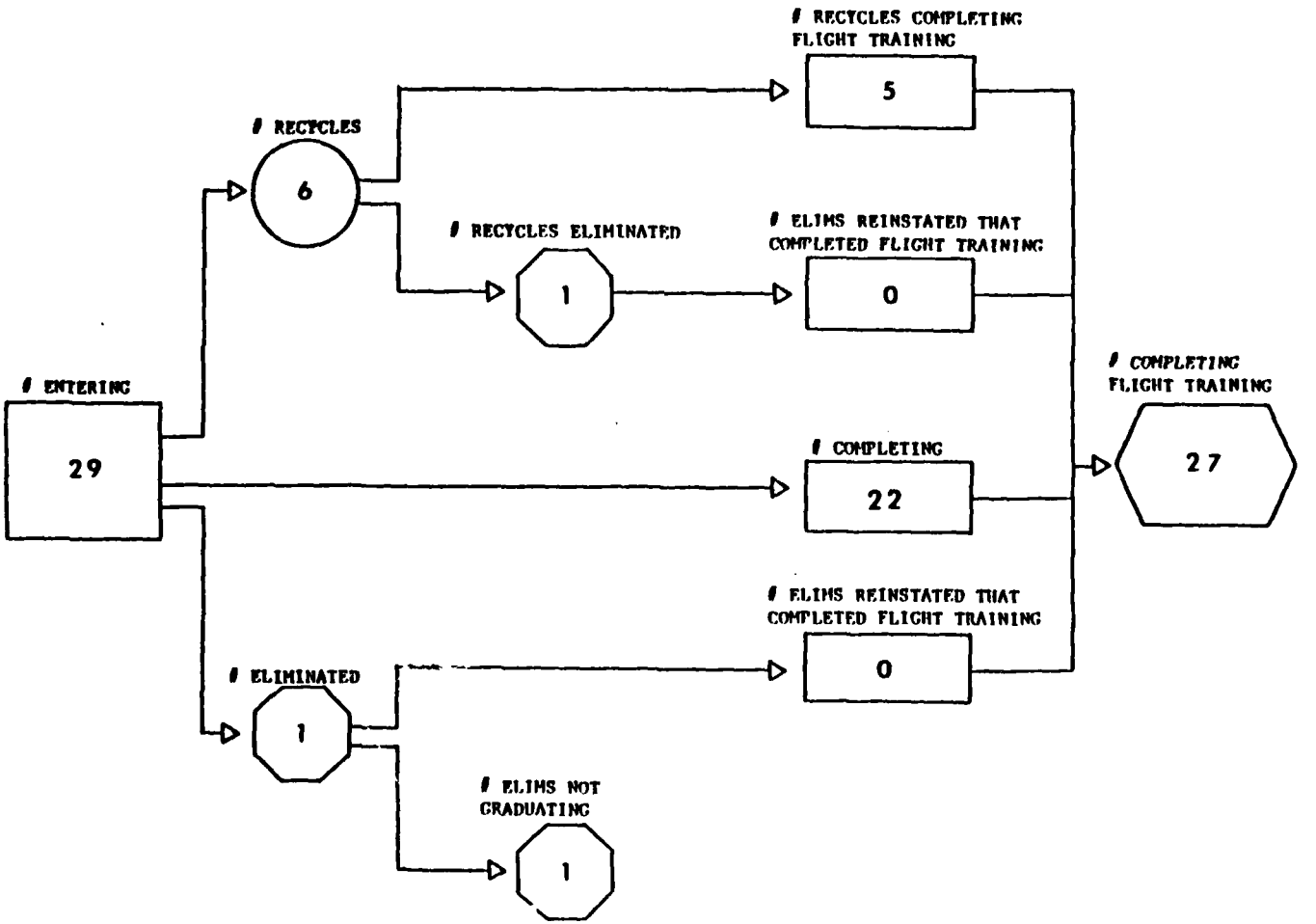


FIGURE H8

FLIGHT TRAINING ATTRITION EXPERIENCE

MINORITY = FEMALE

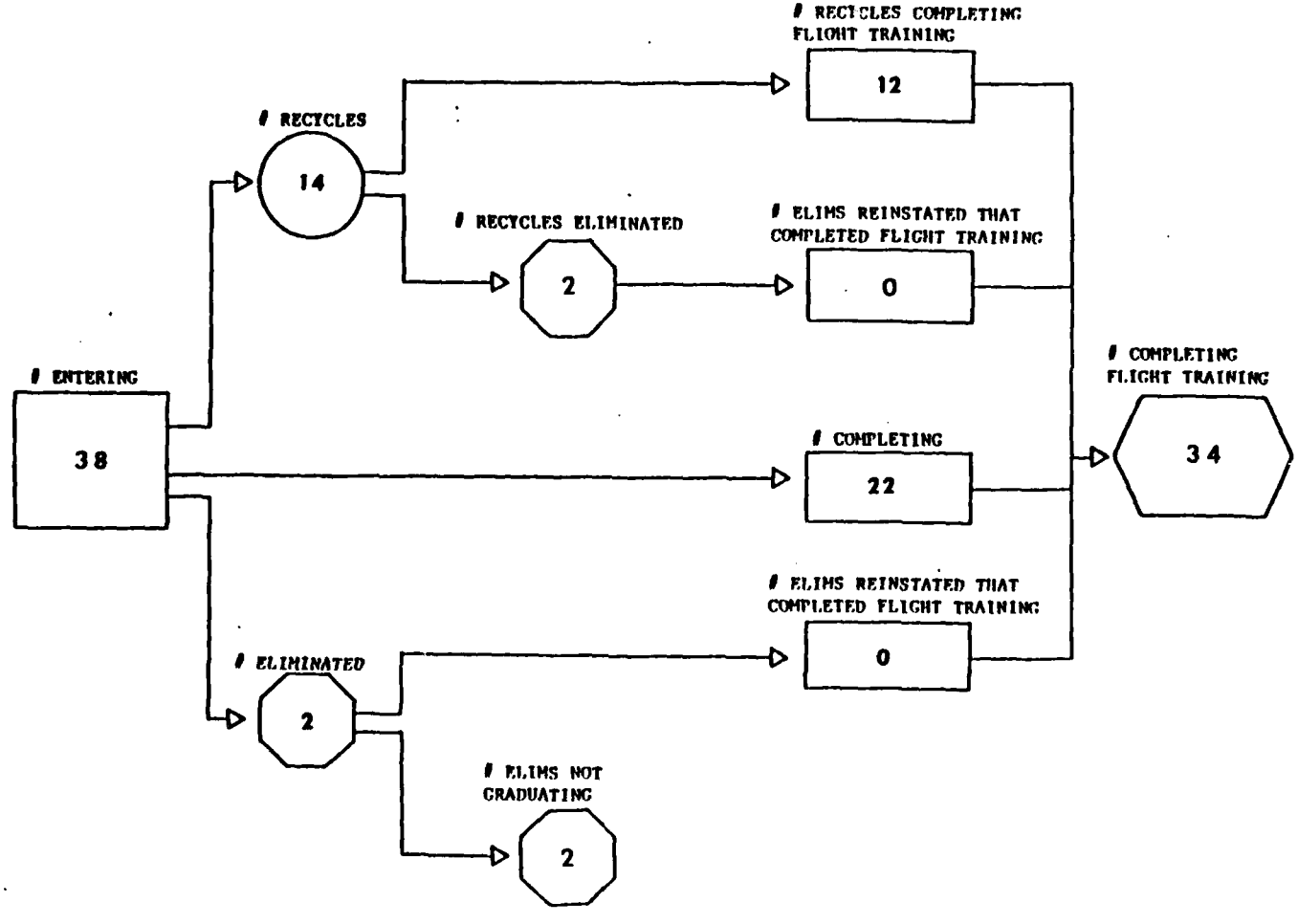


FIGURE H9

FLIGHT TRAINING ATTRITION EXPERIENCE

MATCHED CONTROLS FOR FEMALES

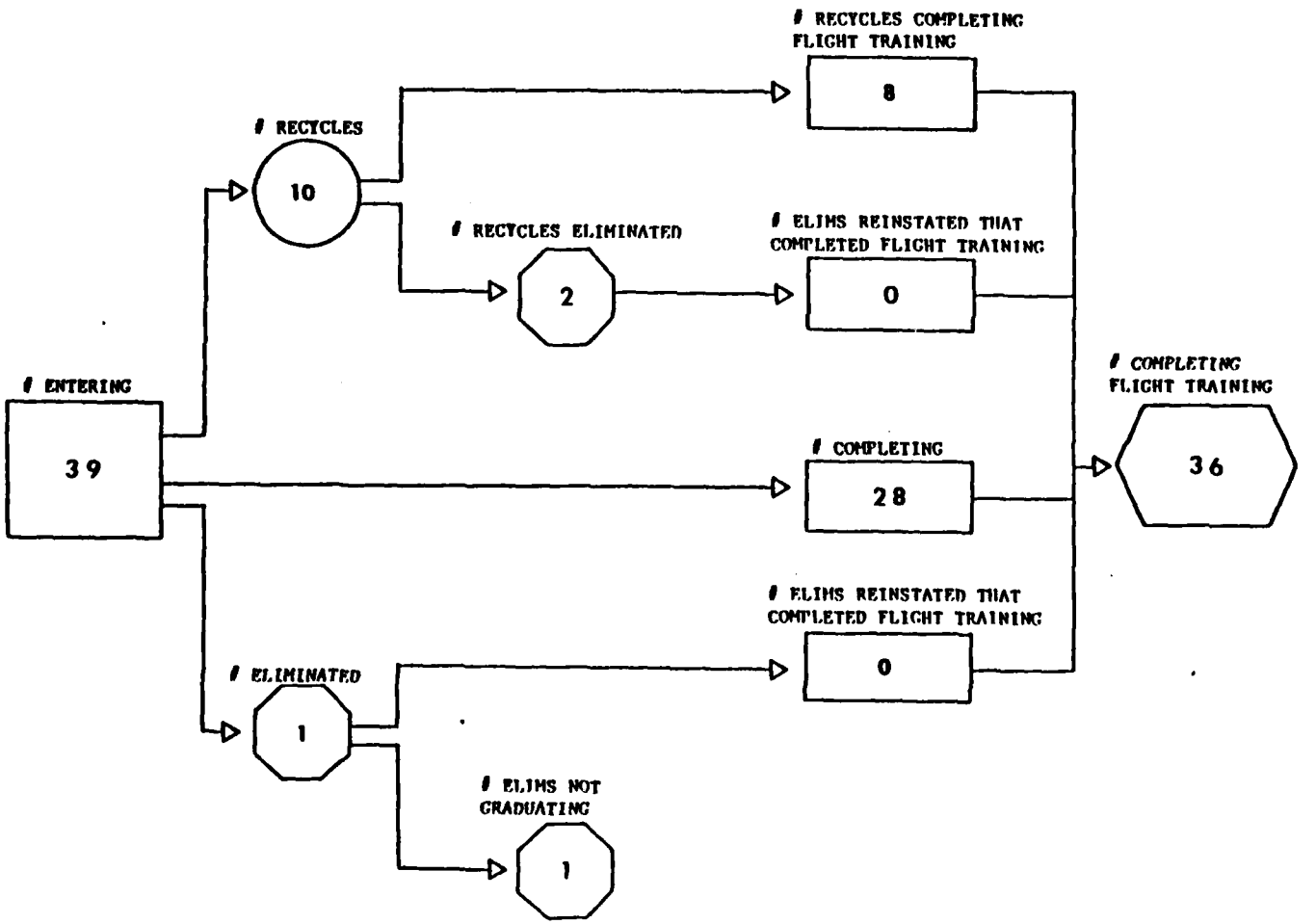


FIGURE H10

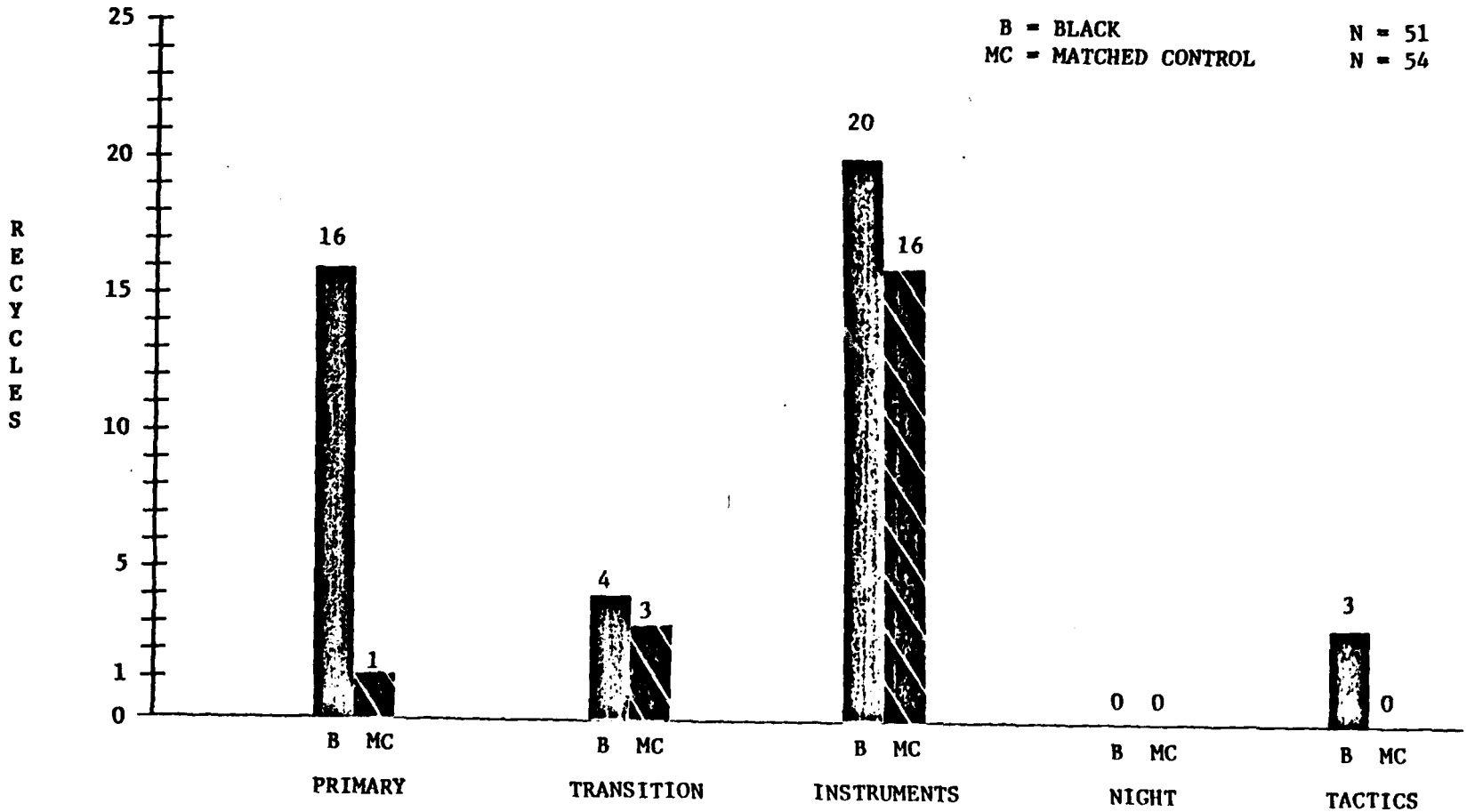
APPENDIX I

COMPARISON OF MINORITY GROUPS AND THEIR MATCHED CONTROLS BY NUMBER OF RECYCLES ACROSS IERW STAGES OF TRAINING

TABLE I1

COMPARISON OF MINORITY GROUP AND THEIR MATCHED CONTROLS BY NUMBER* OF RECYCLES ACROSS IERW STAGES OF TRAINING

MINORITY GROUP = BLACK

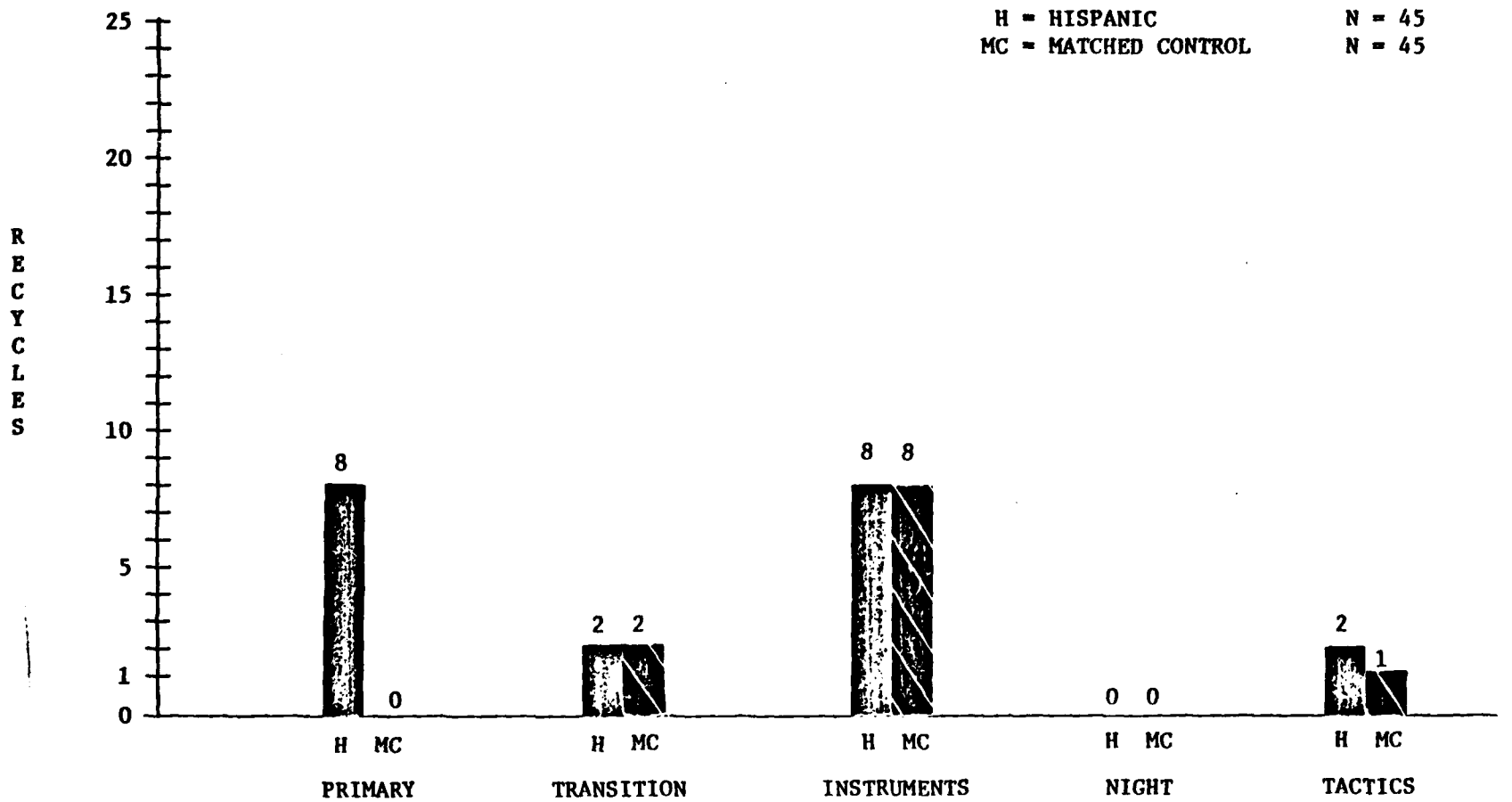


*THE TOTAL NUMBER OF RECYCLES MAY BE GREATER THAN THE NUMBER OF STUDENTS IN EACH GROUP. IF A STUDENT WAS RECYCLED MORE THAN ONCE, EACH RECYCLE WAS COUNTED.

TABLE I2

COMPARISON OF MINORITY GROUP AND THEIR MATCHED CONTROLS BY NUMBER* OF RECYCLES ACROSS IERW STAGES OF TRAINING

MINORITY GROUP = HISPANIC

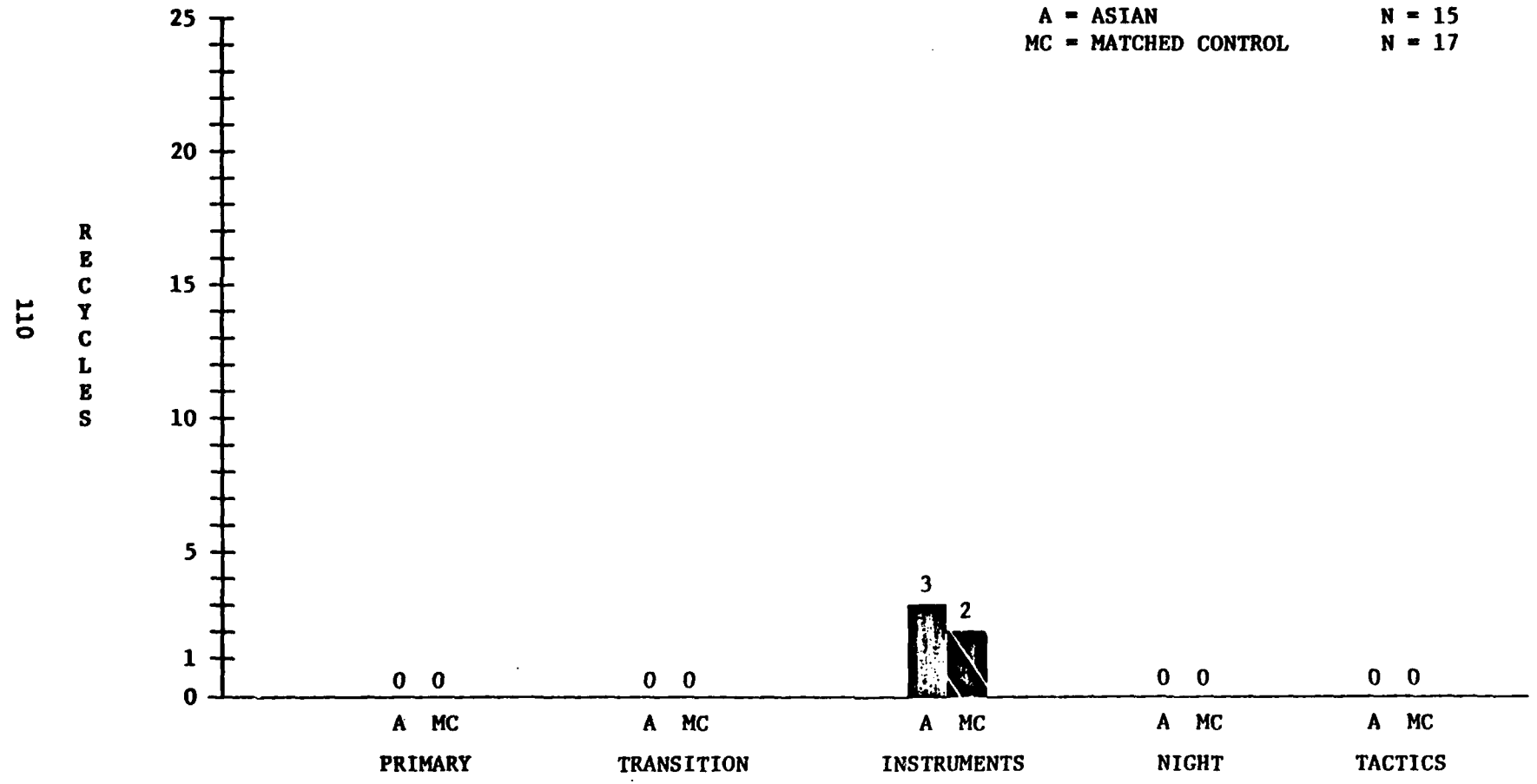


*THE TOTAL NUMBER OF RECYCLES MAY BE GREATER THAN THE NUMBER OF STUDENTS IN EACH GROUP. IF A STUDENT WAS RECYCLED MORE THAN ONCE, EACH RECYCLE WAS COUNTED.

TABLE I3

COMPARISON OF MINORITY GROUP AND THEIR MATCHED CONTROLS BY NUMBER* OF RECYCLES ACROSS IERW STAGES OF TRAINING

MINORITY GROUP = ASIAN

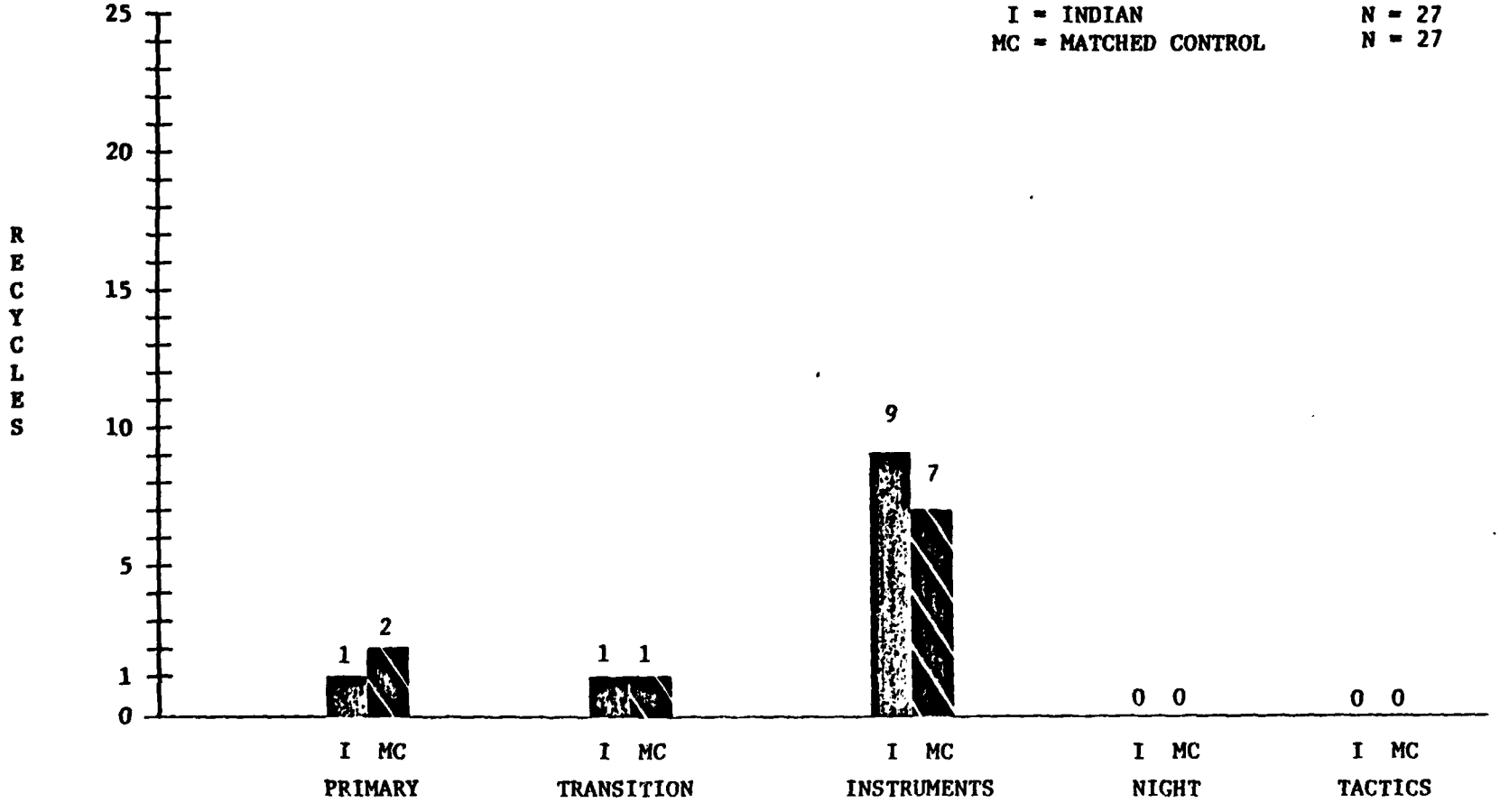


*THE TOTAL NUMBER OF RECYCLES MAY BE GREATER THAN THE NUMBER OF STUDENTS IN EACH GROUP. IF A STUDENT WAS RECYCLED MORE THAN ONCE, EACH RECYCLE WAS COUNTED.

TABLE I4

COMPARISON OF MINORITY GROUP AND THEIR MATCHED CONTROLS BY NUMBER* OF RECYCLES ACROSS IERW STAGES OF TRAINING

MINORITY GROUP = INDIAN

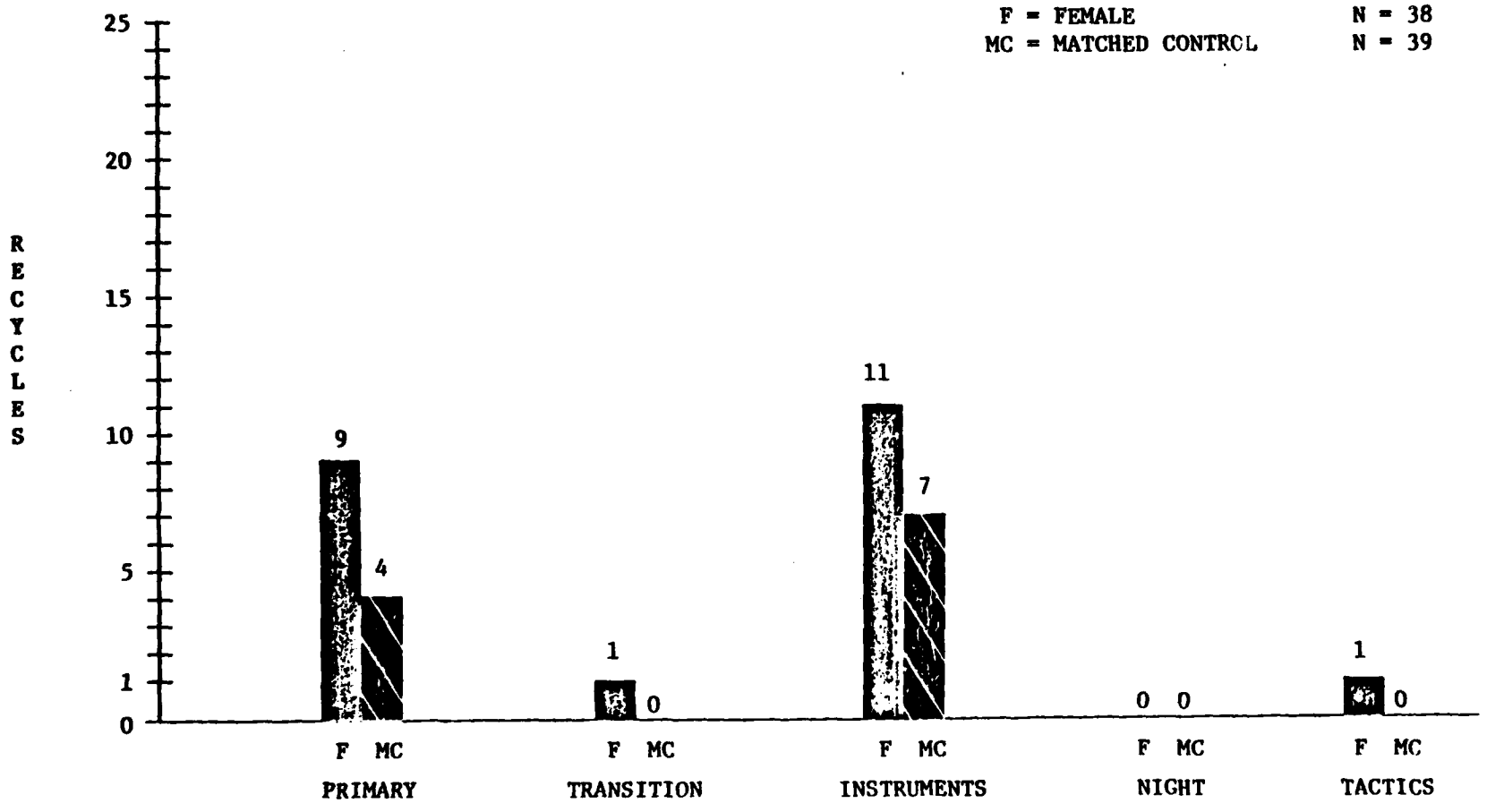


*THE TOTAL NUMBER OF RECYCLES MAY BE GREATER THAN THE NUMBER OF STUDENTS IN EACH GROUP. IF A STUDENT WAS RECYCLED MORE THAN ONCE, EACH RECYCLE WAS COUNTED.

TABLE I5

COMPARISON OF MINORITY GROUP AND THEIR MATCHED CONTROLS BY NUMBER* OF RECYCLES ACROSS IERW STAGES OF TRAINING

MINORITY GROUP = FEMALE



*THE TOTAL NUMBER OF RECYCLES MAY BE GREATER THAN THE NUMBER OF STUDENTS IN EACH GROUP. IF A STUDENT WAS RECYCLED MORE THAN ONCE, EACH RECYCLE WAS COUNTED.

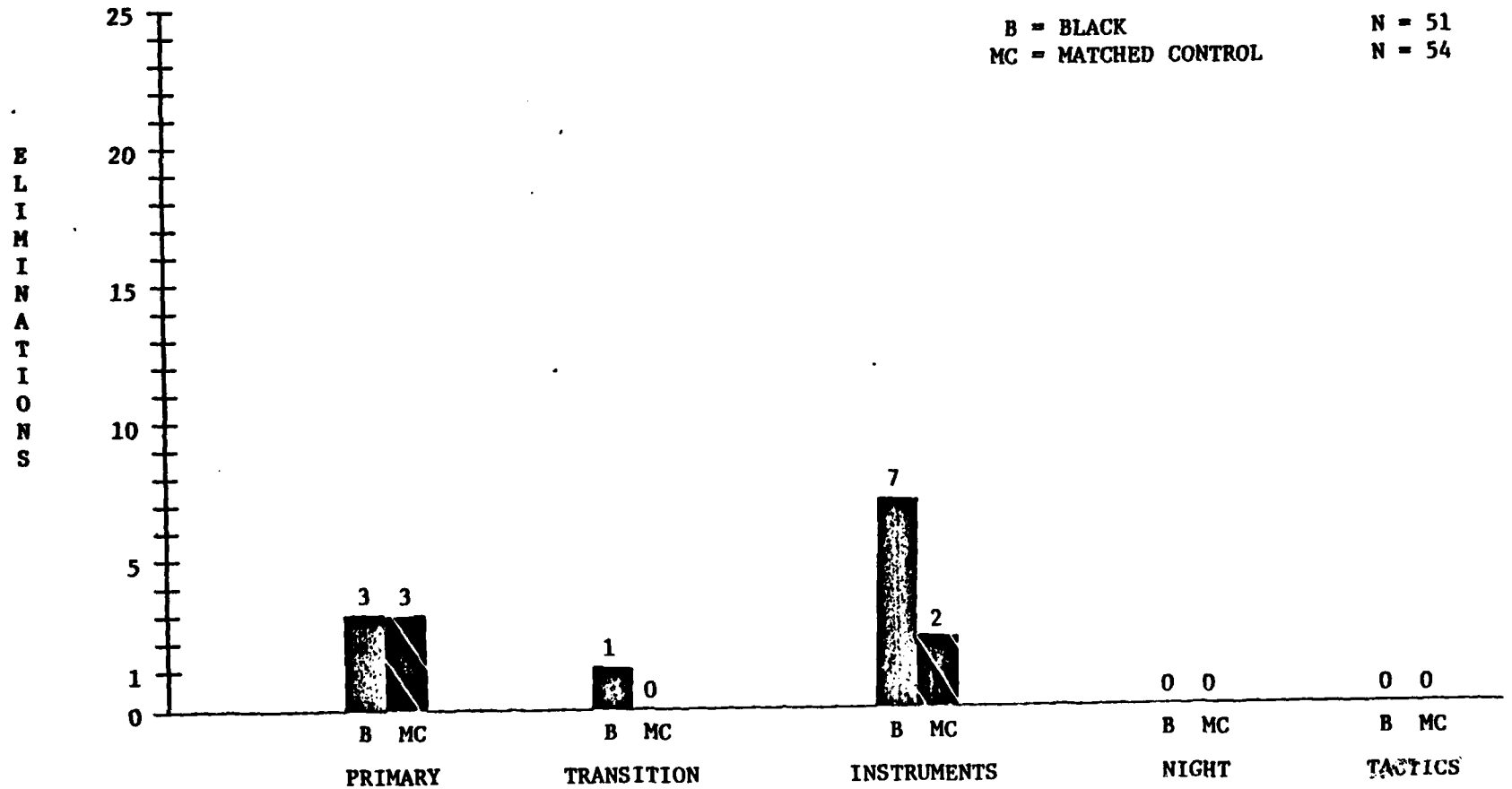
APPENDIX J

COMPARISON OF MINORITY GROUPS AND THEIR MATCHED CONTROLS BY NUMBER OF ELIMINATIONS ACROSS IERW STAGES OF TRAINING

TABLE J1

COMPARISON OF MINORITY GROUP AND THEIR MATCHED CONTROLS BY NUMBER* OF ELIMINATIONS ACROSS IERW STAGES OF TRAINING

MINORITY GROUP = BLACK

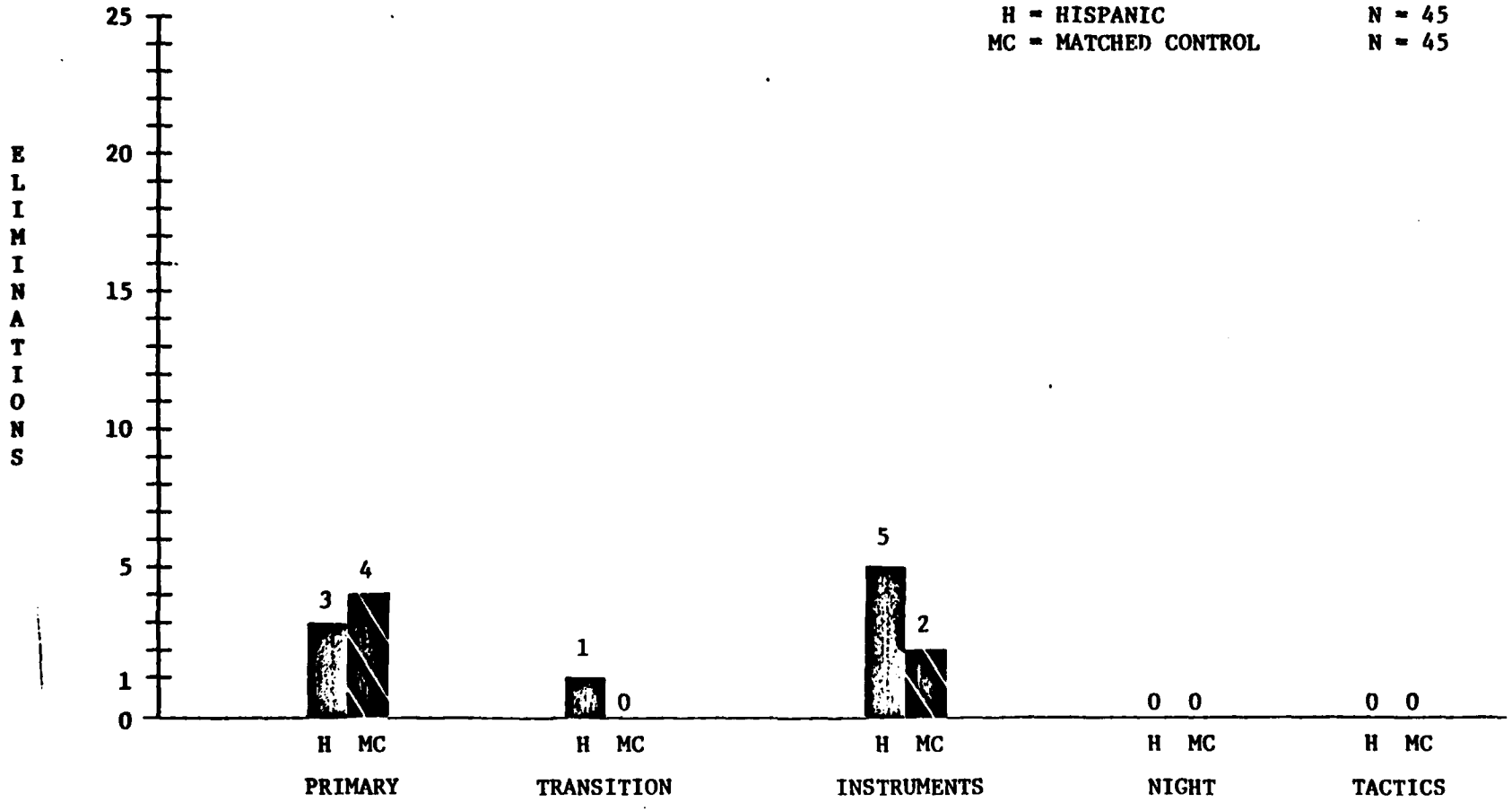


*THE TOTAL NUMBER OF ELIMINATIONS MAY BE GREATER THAN THE NUMBER OF STUDENTS IN EACH GROUP. IF A STUDENT WAS ELIMINATED MORE THAN ONCE, EACH ELIMINATION WAS COUNTED.

TABLE J2

COMPARISON OF MINORITY GROUP AND THEIR MATCHED CONTROLS BY NUMBER* OF ELIMINATIONS ACROSS IERW STAGES OF TRAINING

MINORITY GROUP = HISPANIC

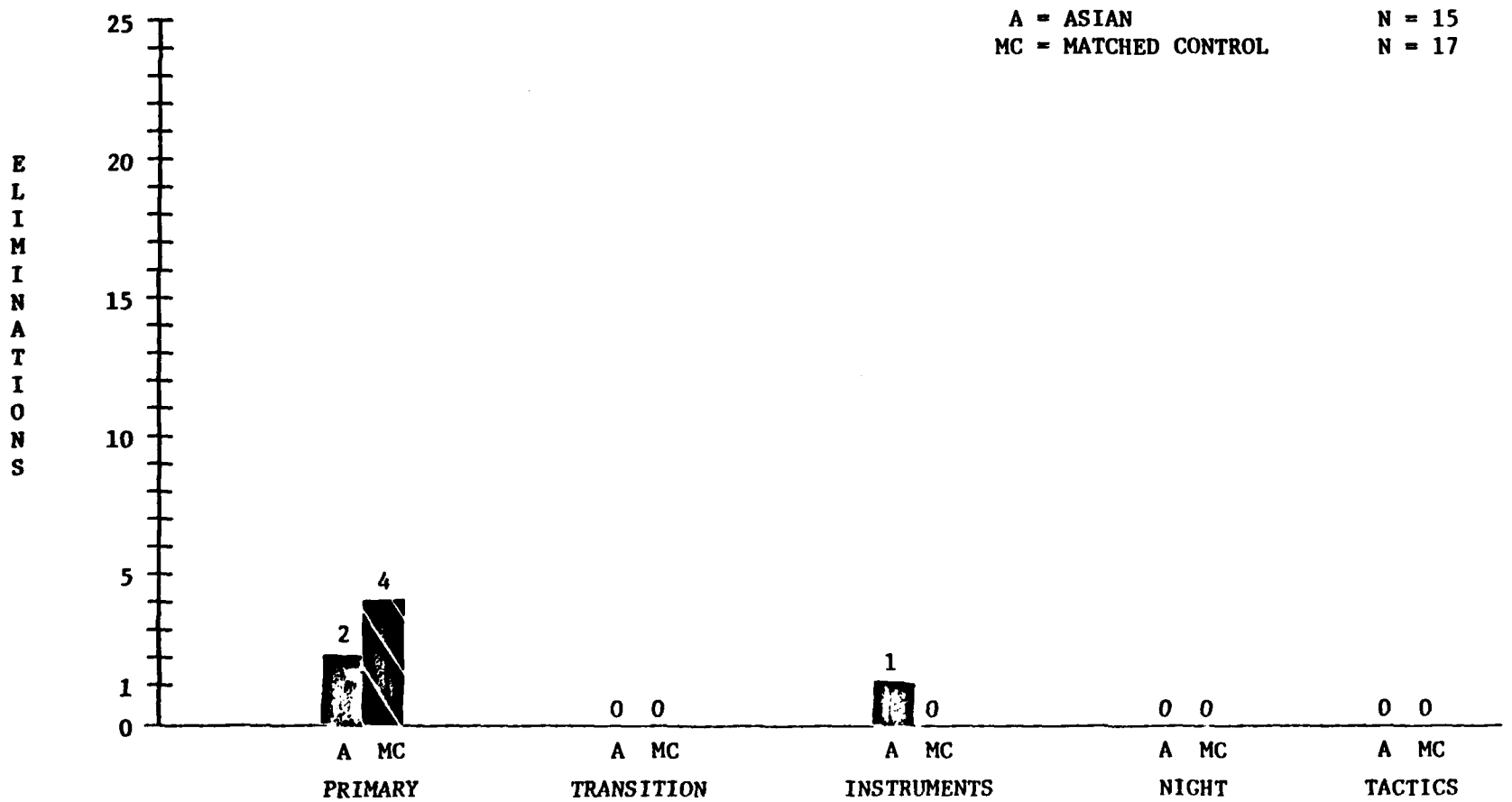


*THE TOTAL NUMBER OF ELIMINATIONS MAY BE GREATER THAN THE NUMBER OF STUDENTS IN EACH GROUP. IF A STUDENT WAS ELIMINATED MORE THAN ONCE, EACH ELIMINATION WAS COUNTED.

TABLE J3

COMPARISON OF MINORITY GROUP AND THEIR MATCHED CONTROLS BY NUMBER* OF ELIMINATIONS ACROSS IERW STAGES OF TRAINING

MINORITY GROUP = ASIAN

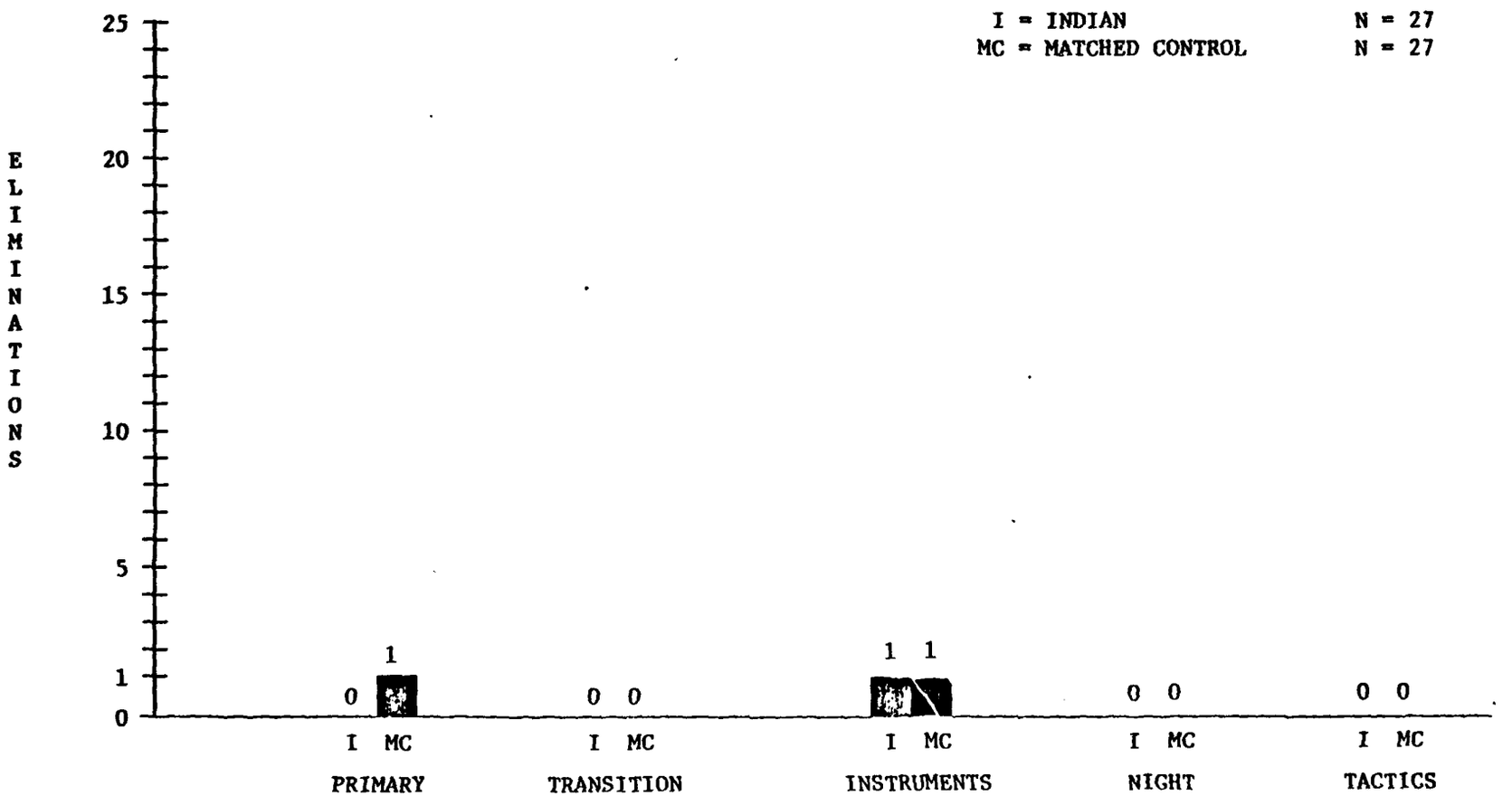


*THE TOTAL NUMBER OF ELIMINATIONS MAY BE GREATER THAN THE NUMBER OF STUDENTS IN EACH GROUP. IF A STUDENT WAS ELIMINATED MORE THAN ONCE, EACH ELIMINATION WAS COUNTED.

TABLE J4

COMPARISON OF MINORITY GROUP AND THEIR MATCHED CONTROLS BY NUMBER* OF ELIMINATIONS ACROSS IERW STAGES OF TRAINING

MINORITY GROUP = INDIAN

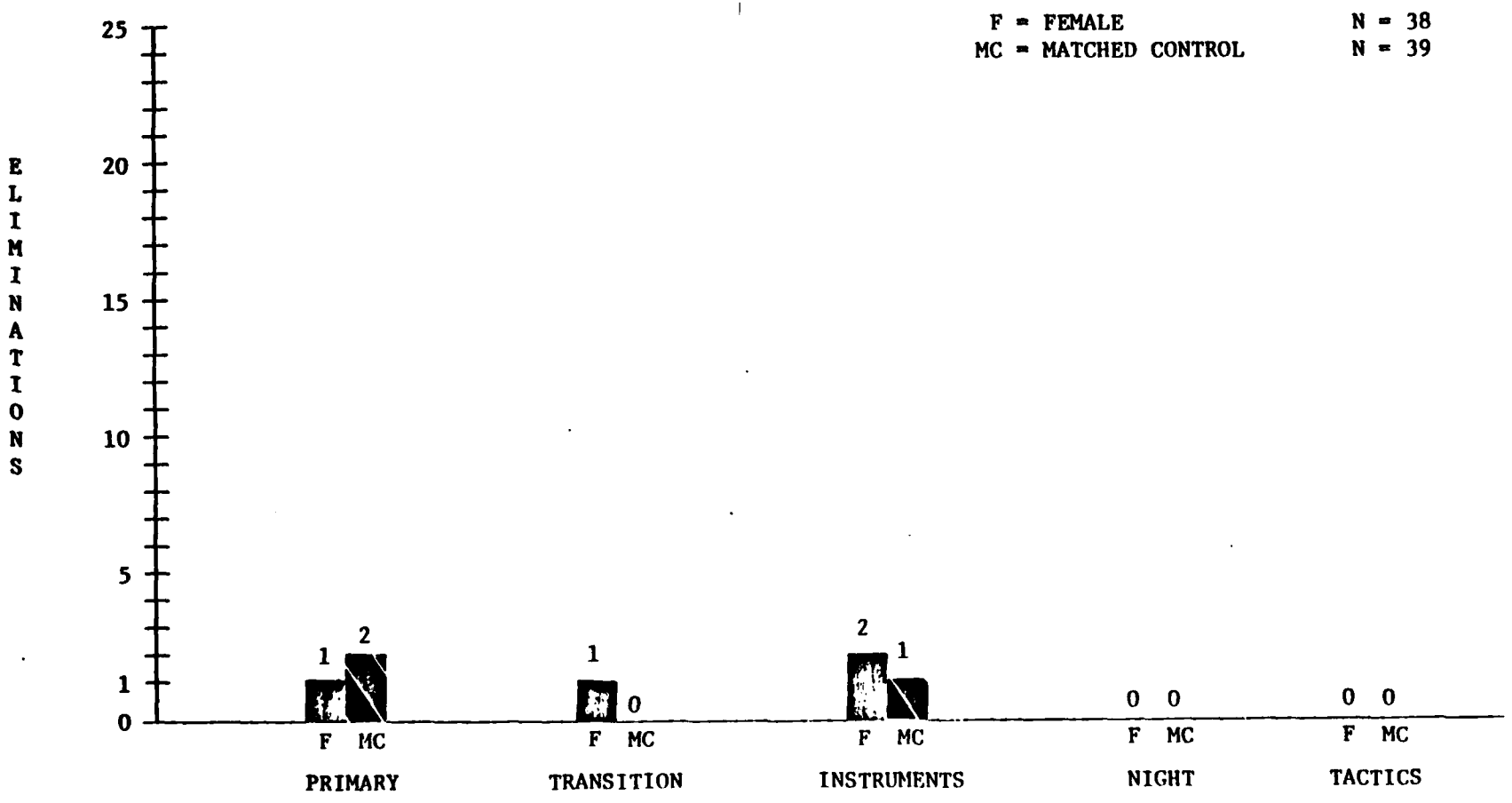


*THE TOTAL NUMBER OF ELIMINATIONS MAY BE GREATER THAN THE NUMBER OF STUDENTS IN EACH GROUP. IF A STUDENT WAS ELIMINATED MORE THAN ONCE, EACH ELIMINATION WAS COUNTED.

TABLE J5

COMPARISON OF MINORITY GROUP AND THEIR MATCHED CONTROLS BY NUMBER* OF ELIMINATIONS ACROSS IERW STAGES OF TRAINING

MINORITY GROUP = FEMALE



*THE TOTAL NUMBER OF ELIMINATIONS MAY BE GREATER THAN THE NUMBER OF STUDENTS IN EACH GROUP. IF A STUDENT WAS ELIMINATED MORE THAN ONCE, EACH ELIMINATION WAS COUNTED.

APPENDIX K

COMPARISON OF WO AND OFFICER ATTRITION EXPERIENCE, BY MINORITY GROUP, DURING IERW FLIGHT TRAINING

COMPARISON OF WARRANT OFFICER AND OFFICER ATTRITION DURING FLIGHT TRAINING

MINORITY = BLACK

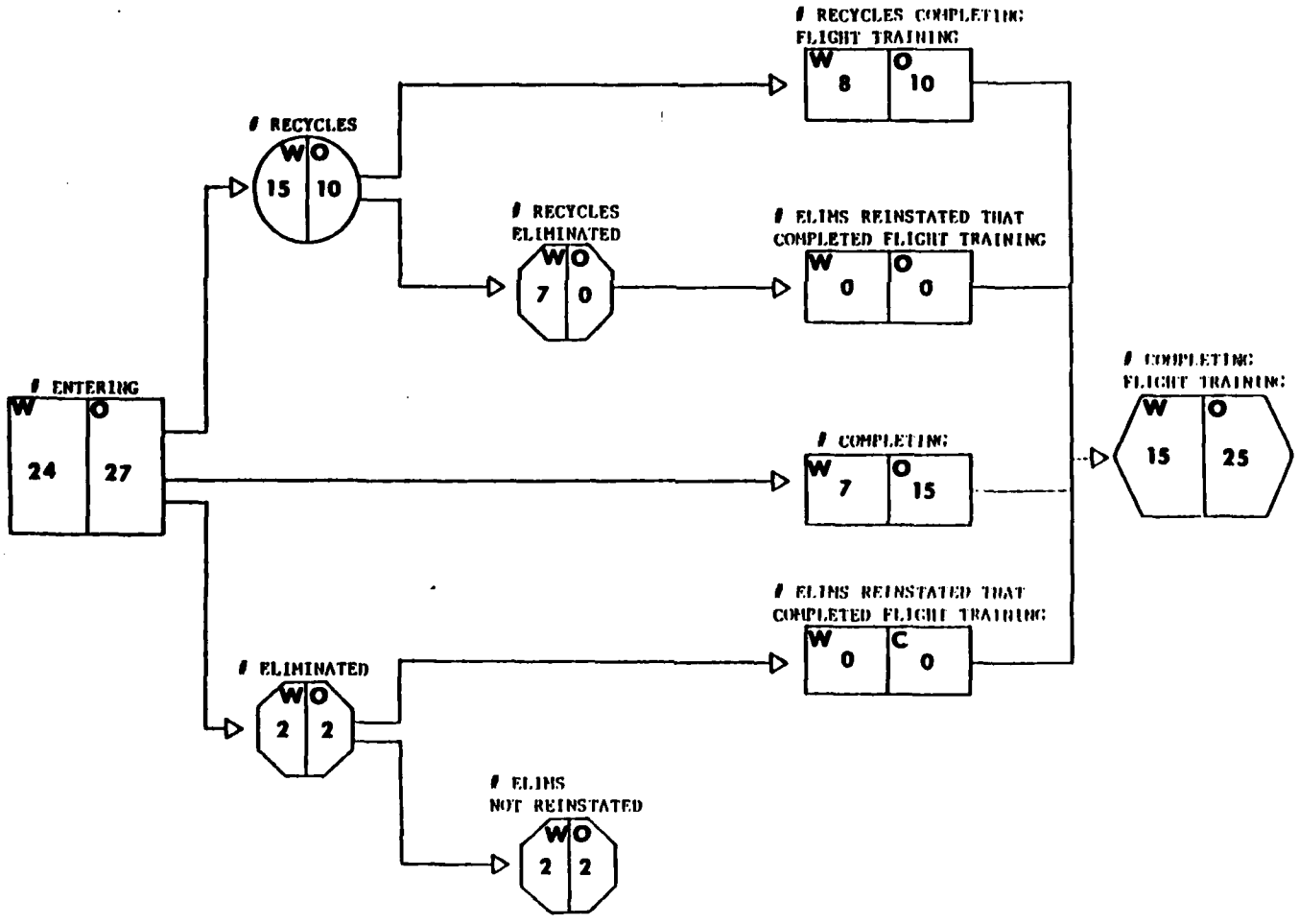


FIGURE K1

COMPARISON OF WARRANT OFFICER AND OFFICER ATTRITION DURING FLIGHT TRAINING

MINORITY = HISPANIC

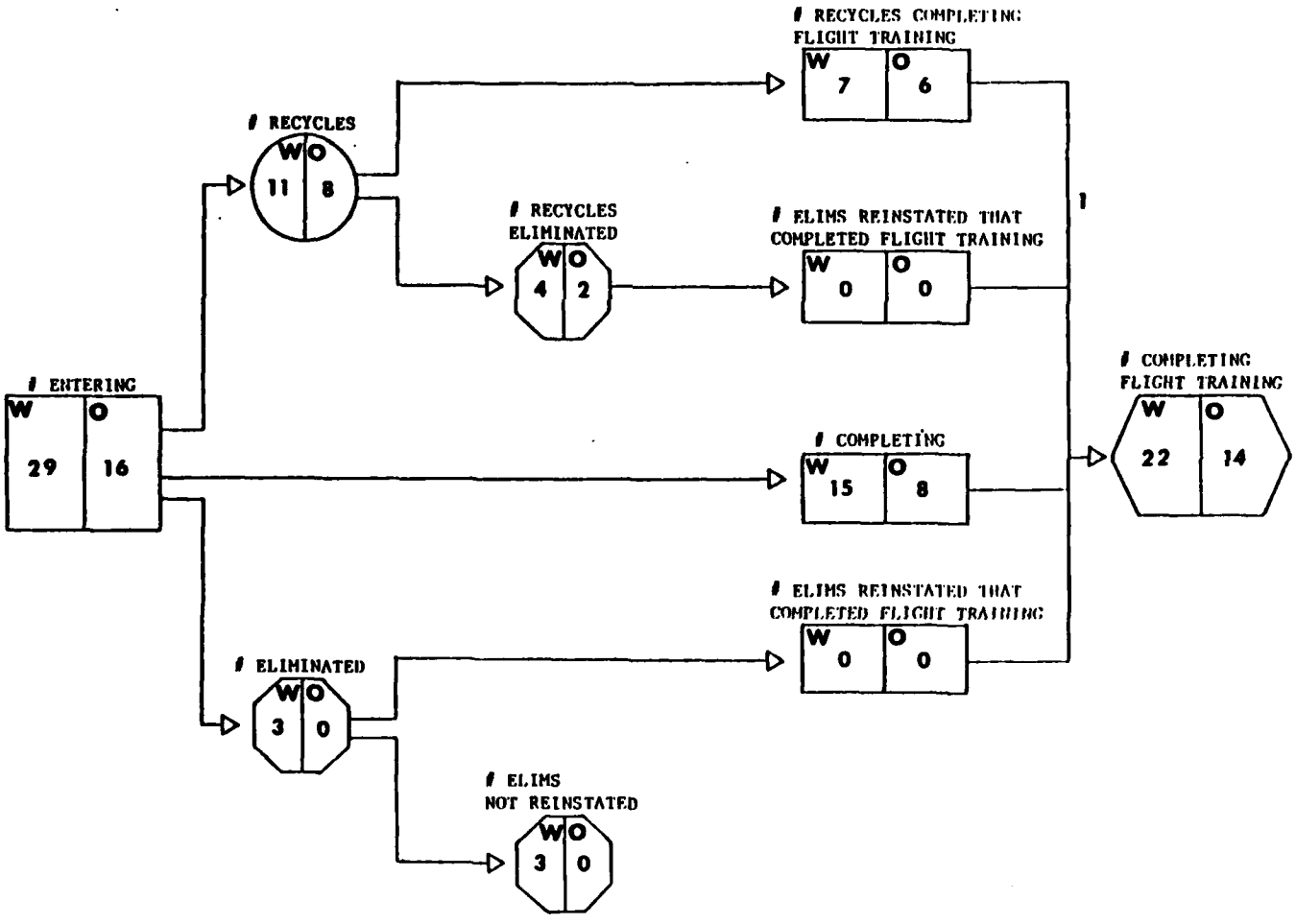


FIGURE K2

COMPARISON OF WARRANT OFFICER AND OFFICER ATTRITION DURING FLIGHT TRAINING

MINORITY = ASIAN

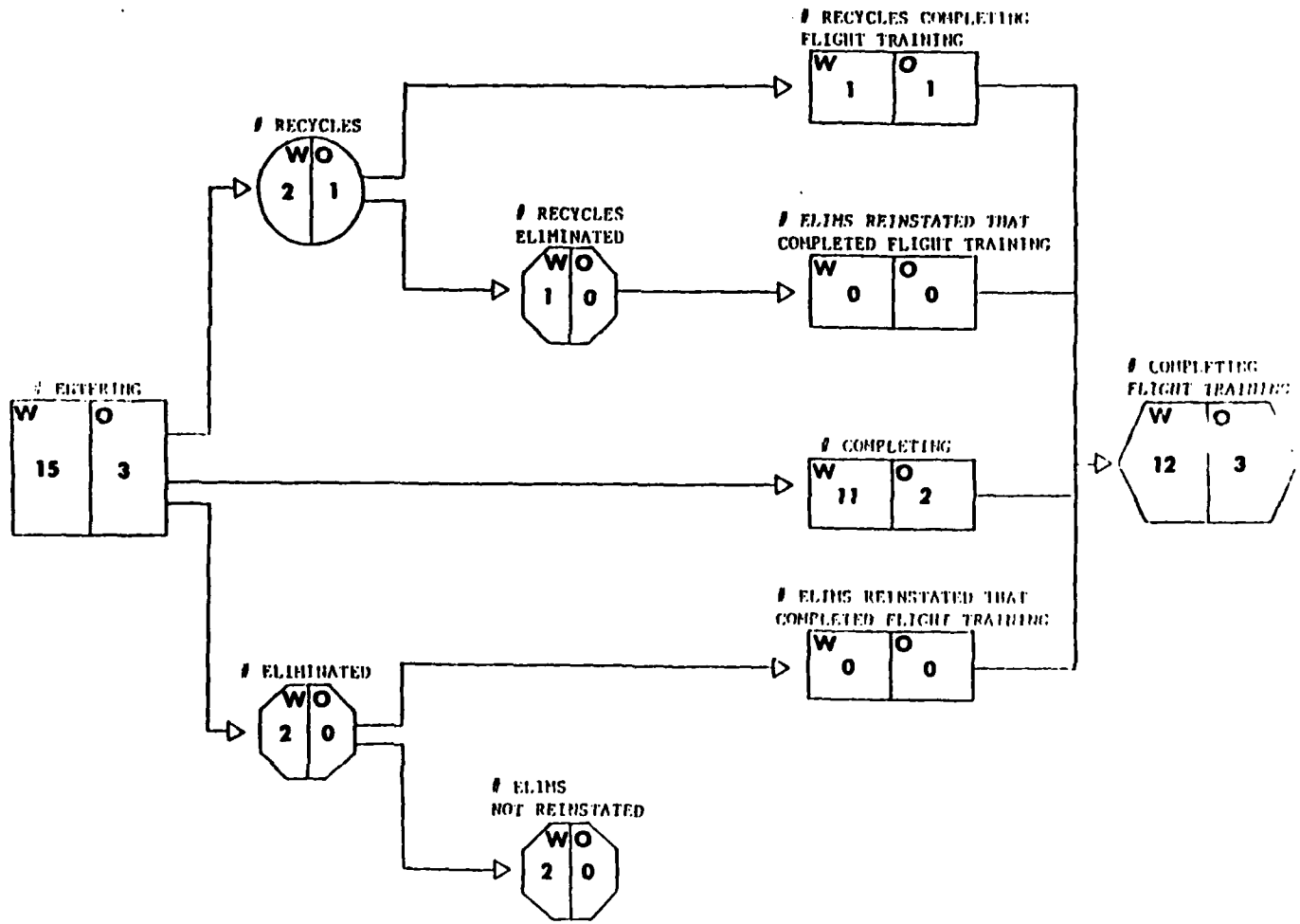


FIGURE K3

COMPARISON OF WARRANT OFFICER AND OFFICER ATTRITION DURING FLIGHT TRAINING

MINORITY = INDIAN

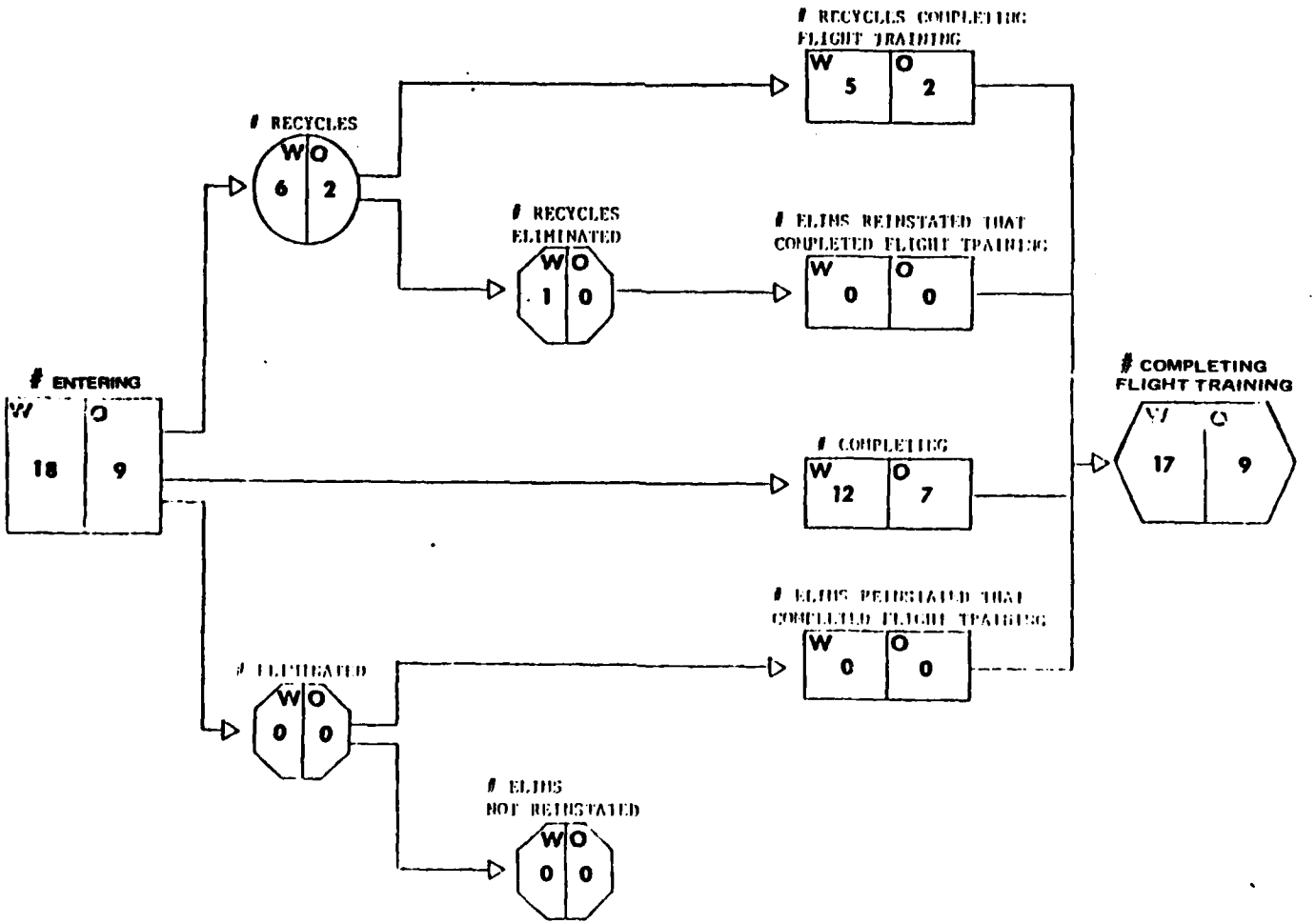


FIGURE K4

COMPARISON OF WARRANT OFFICER AND OFFICER ATTRITION DURING FLIGHT TRAINING

MINORITY = FEMALES

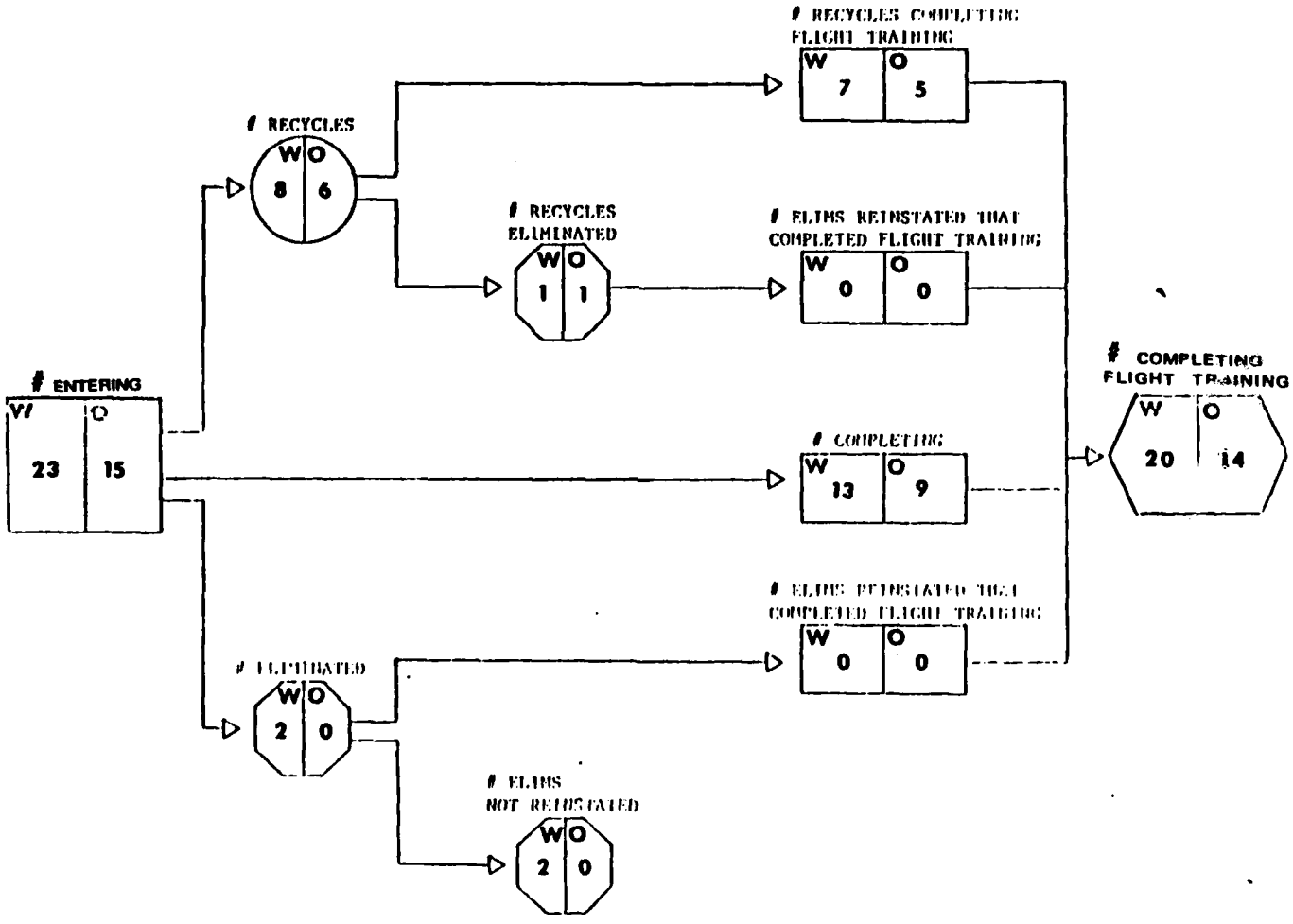


FIGURE K5